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NATIONAL TUBERCULOSIS ASSOCIATION

TRANSACTIONS OF THE EIGHTEENTH ANNUAL MEETING

WASHINGTON, D. C., MAY 4, 5 AND 6, 1922

NATIONAL TUBERCULOSIS ASSOCIATION
370 SEVENTH AVENUE,
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Printed in U. S. A.
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EIGHTEENTH ANNUAL MEETING

OF THE

National Tuberculosis Association

THE Eighteenth Annual Meeting of the National Tuberculosis Association was held at the First Congregational Church, Washington, D. C. on May 4th, 5th, and 6th, 1922.

The meeting was called to order at 9:30 o'clock on Thursday morning by the president, Dr. James Alexander Miller.

Following the address of welcome by the Hon. Charles Evans Hughes, Secretary of State of the United States (page 23) the address of the President was presented and filed for publication in the Transactions. (Page 25). The report of the Executive Office for the year ending May 1, 1922 was presented in abstract and ordered filed. (Page 35).

The President presented Mr. John A. Kingsbury, Secretary of the Milbank Memorial Fund, who announced that the Fund would devote a substantial part of its income for the next five or ten years to tuberculosis work. (Page 17).

The report of the nominating committee which had been appointed in March was presented by the chairman, Dr. Hoyt E. Dearholt. The committee placed in nomination fifty directors, each to serve a two year term. The report of the Committee on Nominations was as follows:

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Col. K. P. Williams, Arkansas.

W. B. Drummond, *Clerk.*

The report of the Nominating Committee was approved and the names were forwarded for formal election to Portland, Me., where the corporate meeting of the members of the National Tuberculosis Association was held on Friday, May 5th, at 10 A. M. The directors listed above were duly and legally elected.

At the general meeting on Thursday morning Mr. Ernest D. Easton Secretary of the New Jersey Tuberculosis League, read the following resolution which had been adopted by the State Secretaries at a meeting the previous day.

"It is with sincere regret that we have learned of the resignation of our Managing Director of the National Tuberculosis Association.

"His tact and ability to meet difficult and trying situations, his wisdom and good humor, have endeared him to the hearts of all secretaries and won their love and respect. His ability to organize and coordinate health activities has strengthened the tuberculosis movement so that it stands today as one of the best, if not the best organized private agency in the world.

"No matter how fortunate we may be in the choice of a successor, we cannot forget the importance of what Dr. Hatfield's leadership has meant to our cause. We hope that his experience, counsel and advice will continue to be available and sought for, and that his spirit and influence will be with us and inspire us to greater accomplishments."

It was moved that the resolution be adopted by the members of the Association by a rising vote. The audience arose and applauded and in response Dr. Hatfield spoke as follows:

"It is needless to say how much I appreciate the action you have taken, and how especially I appreciate it from my friends, the State Secretaries.

"We have had tense moments, but I have found that as I knew the individuals better the more easy it was for us to get along; so that I want to promise, or rather threaten, that there will be no diminution of my interest in the work and especially in the work of the State Secretaries. I also want to threaten the representatives of the affiliated associations that on occasion, I may break into their deliberations and talk to them, as I have talked before."

"As I have said before, it is a matter of sincere regret to me to be giving up the work; but it is also a matter of rejoicing to know that the work has developed satisfactorily. I rejoice also in the certainty that the managing directorship is left in the very capable hands of Dr. Williams."

About 750 persons were registered at the meeting and a considerable number who attended were not registered.

The Clinical Section held three meetings and the Pathological Section two meetings. A combined session of the Clinical and Pathological Sections was also held. The Advisory Council held one session, the Sociological Section three sessions and the Nursing Section two sessions. There was also a session devoted to the Modern Health Crusade, and a Crusade Luncheon at which several distinguished speakers representing foreign countries talked on the international aspects of the Modern Health Crusade.

The following Committee on Resolutions was appointed by the President.

Dr. George M. Kober, *Chairman*, Washington, D. C.;
Dr. W. McN. Miller, St. Louis;
Dr. Vincent Y. Bowditch, Boston;
Dr. E. R. Baldwin, Saranac Lake;
Dr. J. W. Pettit, Ottawa, Ill.

On behalf of the Committee on Resolutions, Dr. George M. Kober, Chairman, presented the following resolutions with the endorsement of the committee. Each of the resolutions was adopted unanimously.

1. Resignation of Dr. Hatfield.

WHEREAS, Dr. Charles J. Hatfield, Managing Director of the National Tuberculosis Association since 1914 has tendered his resignation to its Board of Directors, and

WHEREAS, The Board of Directors after prolonged consultation with Dr. Hatfield have concluded that they have not the right to insist upon the personal sacrifices which a further retention of this office would impose upon him, it is therefore

Resolved, That the National Tuberculosis Association assembled in its 18th Annual Meeting, expresses to Dr. Hatfield the utmost regret that he has relinquished his leadership, and extends its grateful appreciation of the wisdom, patience and untiring energy that have characterized his direction of the activities throughout these years, manifested by the unprecedented development of the fruitful work of this Association due chiefly to his efforts and to those of his predecessor, Dr. Livingston Farrand.

The splendid record of Dr. Hatfield is ample evidence that his heart and mind will continue in the great work in which we are engaged and the Association cherishes the hope that he may receive his greatest reward in health, happiness and, with the oncoming years, the full realization of duties faithfully performed.

2. Training for Medical Officers of the Veterans' Bureau.

WHEREAS, The most satisfactory results in the administration of the present and proposed tuberculosis hospitals of the Veterans' Bureau depend upon a corps of well trained medical personnel, be it

Resolved, That the National Tuberculosis Association assembled in its 18th Annual Meeting suggests to the Director of the Veterans' Bureau that he authorize the Medical Division to take immediate steps for securing ample special training in diagnosis, treatment, and hospital administration of medical officers of the Veterans' Bureau.

3. Nurses' Training School at Veterans' Hospital.

WHEREAS, It has been found difficult to secure for service in hospitals caring for veterans suffering with tuberculosis a sufficient number of nurses qualified to serve in these hospitals, and

WHEREAS, The school conducted by the Public Health Service at Hospital No. 60, Oteen, North Carolina, from September 1 to 30, 1921, for nurses serving in Public Health Service hospitals has proven of great value, and

WHEREAS, Advantage can be taken of the presence of qualified physicians to give the lectures and of all the facilities that are in existence at Hospital No. 60, Oteen, North Carolina, be it

Resolved therefore, That it is the sense of this meeting that the course should be conducted under the auspices of the Veterans' Bureau, June 1 to 30, 1922 as proposed by the Public Health Service, and that these resolutions be forwarded to the Director of the U. S. Veterans' Bureau for his consideration.

4. Federal Hospital Program.

WHEREAS, One of the results of the recent war has been the necessity that the United States Government provides hospital care for a very large number of ex-service men suffering, not only from injuries, but from a number of chronic diseases, including tuberculosis, nephritis, diabetes and mental diseases, and

WHEREAS, The Secretary of the Treasury has provided, through a Board of Consultants, and its Advisory Committee, representing national voluntary health bodies, a carefully studied and comprehensive Federal hospital program; therefore, be it

Resolved, That this Association hereby expresses its hearty approval and appreciation of the action of the Secretary of the Treasury and of the work of the Board of Consultants which he appointed.

5. Cooperation with Consultants on Hospitalization.

WHEREAS, This meeting has heard with pleasure the report of the Managing Director and the appreciative remarks of the Surgeon General of the United States Public Health Service concerning the cooperation of the Executive Staff of the National Tuberculosis Association with the several Government Departments concerned with the care, treatment, and training of tuberculous ex-service men; and also the cooperation with the Consultants on Hospitalization to the Secretary of the Treasury; and

WHEREAS, Many of the Directors and individual members of the Association have also cooperated with the Government in various ways in the same problem, be it

Resolved, That this meeting hereby expresses its approval of this record of service by members and officials of the National Tuberculosis Association; and would request that the Board of Directors convey to the Government Departments concerned, an expression of appreciation for the opportunities of service on behalf of tuberculosis ex-service men in the past, and an offer of continued cooperation and service in the future.

6. Health Education Among Negroes.

WHEREAS, The incidence of tuberculosis amongst Negroes remains still high, and

WHEREAS, These resulting foci of dissemination continue to both whites and Negroes, be it

Resolved, That the National Tuberculosis Association urge all national, state and local health agencies, official and volunteer, to institute and conduct a vigorous campaign of health education amongst Negroes in all territories coming within their respective jurisdictions.

7. Appreciation of Secretary of State Hughes.

WHEREAS, The great success of this meeting of the National Tuberculosis Association was initiated by the participation in, and by the inspiring and scholarly address of the Honorable Charles E. Hughes, Secretary of State, be it

Resolved, That the National Tuberculosis Association deeply appreciates the self-sacrifice and devotion of Secretary Hughes in his helpfulness, and that its thanks be gratefully accorded.

8. Appreciation of Dr. Miller.

Resolved, That the National Tuberculosis Association extends to Dr. James Alexander Miller, the retiring President, sincere appreciation of his successful and faithful administration during his term of office.

9. Mr. Baldwin's Illness.

WHEREAS, The National Tuberculosis Association has heard with deep regret of the severe illness of its former Treasurer, Mr. William H. Baldwin, who has for so many years devoted his energies to philanthropic work, and especially to the work of this Association; be it

Resolved, That the National Tuberculosis Association assembled in its 18th Annual Meeting, extends to Mr. Baldwin its sympathy in his illness and its most earnest hope for his speedy and complete recovery.

10. Preparation of History.

Resolved, That the thanks of the National Tuberculosis Association be extended to Dr. S. Adolphus Knopf for his faithful and painstaking care in the preparation of the "History of the National Tuberculosis Association" to which service he has devoted the past two years.

11. In Memoriam.

WHEREAS, In the past year the National Tuberculosis Association has lost the valuable service of a devoted and untiring worker in the death of Jules Schevitz, Executive Secretary of the Oklahoma Public Health Association, be it

Resolved, That expression be given to the appreciation of the Association for the service which he rendered and its grief in the loss suffered by his untimely death in the midst of his labors.

12. Appreciation of Local Arrangements.

WHEREAS, The Members of the National Tuberculosis Association are under great obligation to those in Washington who have assisted in making the 18th Annual Meeting a notable event, be it

Resolved, That the hearty thanks of the members be extended to the Trustees of the First Congregational Church and to the Pastor, Reverend Dr. Jason Noble Pearce for the excellent accommodations provided for the sessions of the 18th Annual Meeting; also to the local committee of arrangements, working under the efficient Chairmanship of Mr. Emil Berliner and to all others who have contributed time and effort to the success of the meeting.

At a meeting of the Board of Directors on Saturday, June 6th the following officers were elected for the ensuing year:

Dr. Lawrason Brown, New York, President.

Honorable Warren G. Harding, District of Columbia, Honorary Vice-President.

Colonel George E. Bushnell, Massachusetts, Honorary Vice-President.

Dr. Charles J. Hatfield, Pennsylvania, Vice-President.
Dr. J. W. Pettit, Illinois, Vice-President.
Dr. George M. Kober, District of Columbia, Secretary.
Mr. Henry B. Platt, New York, Treasurer.

The following directors, in addition to the President, the Vice-Presidents, the Secretary and the Treasurer, ex-officio, were elected to serve on the Executive Committee for the ensuing year.

Dr. C. C. Browning, California.
Dr. W. L. Dunn, North Carolina.
Dr. David R. Lyman, Connecticut.
Dr. John H. Peck, Iowa.
Dr. A. M. Forster, Colorado.
Mr. John A. Kingsbury, New York.
Dr. James A. Miller, New York.

* * * * *

CONTROL OF TUBERCULOSIS TO BE AIDED BY THE MILBANK MEMORIAL FUND

John A. Kingsbury: The Board of Directors of the Milbank Memorial Fund has authorized me to make an announcement concerning an important undertaking to which the Fund will devote a substantial part of its income for the next five or ten years; and it seems to the Board that this is a peculiarly appropriate time and place to give out such an announcement as we have to make.

First of all, let me explain that, contrary to popular opinion, the Milbank Memorial Fund is not a new member of the family of philanthropic foundations. It is newly known; and it has become quite generally known only since the death in February, 1921, of Mrs. Elizabeth Milbank Anderson, who established and endowed it as a memorial to her father, Jeremiah Milbank, in 1905. Until Mrs. Anderson's death, however, it was known to its circle of acquaintances as the Memorial Fund Association. Under that name it had a long and varied list of beneficiaries to which it has been loyal for over fifteen years.

Like its founder, it has had a catholicity of interests ranging from emergency relief to research and religion; and like Mrs. Anderson, its helpful influence has been felt on at least four continents and without regard to race or religion.

Neither Mrs. Anderson nor the Fund has been indiscriminate in their giving, and during recent years there has been a growing tendency to specialize in public health undertakings and in child welfare work. The Fund has been carefully administered by a Board of Directors of which from its incorporation Edward W. Sheldon has been President and Albert G. Milbank, Treasurer. The other members of the Board are Senator Root, John G. Milburn, Thomas Cochran, George J. Nichols and Dr. Charles M. Cauldwell.

Since Mrs. Anderson's death the Board has been considering various proposals of a distinctive character which it might be appropriate to undertake,—something which would be in the nature of a memorial to Mrs. Anderson, something characteristic of her dominant interest and her methods. Mrs. Anderson supported the research work at Trudeau from the beginning—and to the end. Many of the leaders in the scientific aspects of tuberculosis received their training in that little laboratory in Saranac on Dr. Trudeau's home lot, and there they supported themselves while

regaining their health. Mrs. Anderson was also vitally interested in the practical measures for the control of tuberculosis. She was the largest contributor to that important demonstration in the efficacy of the home treatment of tuberculosis—the Home Hospital in New York City.

After considering the wide variety of suggestions and possibilities, the Board has reached the conclusion that the most promising opportunity for the improvement of health, the prevention of dependency and distress, and the betterment of living conditions, in New York State and throughout the country, is in the more intensive and rapid development of the movement for the control of tuberculosis. In reaching this conclusion the Board has had the advice of leading health authorities, social workers and economists, including among others Dr. William H. Welch, Dr. Hermann M. Biggs, Dr. Livingston Farrand, Mr. Homer Folks, Dr. James Alexander Miller, Dr. Edward R. Baldwin, Dr. Lawrason Brown, Dr. Charles J. Hatfield, Dr. Allen K. Krause, Dr. Lee K. Frankel, Dr. Donald B. Armstrong, Prof. E. R. A. Seligman, Prof. William G. Wilcox, Dr. Louis I. Dublin, Mr. Henry S. Dennison, and Mr. Bailey B. Burritt. Indeed I think it is safe to say that the Board has consulted not only all of the past presidents of the National Tuberculosis Association who were within hailing distance, but also many of the future presidents as well.

In the opinion of the advisors of the Board, the practicability of a much greater degree of control of tuberculosis than has yet been attained generally has been quite conclusively shown by the extraordinary decrease in the tuberculosis morbidity and mortality in Framingham, Mass., secured through the demonstration directed by the National Tuberculosis Association and financed by a grant from the Metropolitan Life Insurance Company. We are informed that the tuberculosis mortality in Framingham has been reduced during the past five years 67 per cent, whereas during the same period of time in a group of Massachusetts communities of about the same size and character, as Framingham, selected as control towns, the decrease has been only 18 per cent. There have been other notable reductions in tuberculosis mortality called to our attention, particularly in communities in which special effort has been made to that end.

The chief features of the Framingham demonstration have been the more intensive application of what are generally accepted as sound anti-tuberculosis measures, all of which are too well known to require enumeration here among those who have discovered, invented or exploited them. The total cost of these efforts in Framingham, which has now been taken over almost wholly by local authorities and local agencies is, as most of you know, $2.40 per capita of population per annum.

The Milbank Memorial Fund has in mind the desirability of similar demonstrations among larger groups of population and under a variety of conditions. The localities to be selected may include a rural county of 50,000 to 60,000 inhabitants, a city of from 75,000 to 100,000 population, and a district including a population of at least 100,000 in some one of the large cities of the state if there is a demand for it. The actual operation of the activities undertaken will be in the hands of local authorities and agencies. Applications from localities will be considered with reference to the amount of tuberculosis prevailing, the agencies already developed, and more particularly with reference to the desire of authorities and agencies to secure as complete control as possible of tuberculosis within their localities in a reaonable period of time. Complete co-operation of all local factors will of course be an essential element.

The purpose of the demonstrations is to determine whether any American community, with proper organization and at reasonable expense, can reduce its tuberculosis morbidity and mortality, as apparently has been done in Framingham, to a

nominal minimum, and to ascertain the proper organization and the per capita costs of such undertakings applied to large cities and rural counties.

The Milbank Memorial Fund proposes to work through the National, state and local tuberculosis health authorities and agencies in developing its demonstrations and will not establish an operating board. It contemplates, however, appointing an Advisory Council with which it will confer in maturing its plans and for the purpose of discussing the demonstrations as they develop. It contemplates securing also the continuous counsel and advise of a smaller group of technical experts on whose specific recommendations the Board will for the most part base its important decisions.

The demonstrations will be in New York State where any community will be eligible for consideration, but only those will be selected for the demonstrations whose health agencies, public and private, are willing to combine in assuring the greatest possible assistance and cooperation. A fund of between $300,000 and $400,000 annually for the next five years will be available for the purpose of these demonstrations. That is to say a total of approximately $2,000,000. Naturally, the fund looks toward the assumption by the local agencies and authorities of the responsibility for continuing and developing the various phases of the anti-tuberculosis effort as each has proved its success.

It is the hope of the Directors of the Milbank Fund that these demonstrations conducted on the scale I have indicated will give a great impetus to the movement for the prevention of tuberculosis in this country, and that the example of the localities, selected as typical of the population of the country as a whole, will be taken up by other cities and counties and will thus greatly accelerate a large degree of control of tuberculosis which now seems to be clearly possible by sufficient effort.

* * * * * * *

At a general meeting on Saturday, May 6th, at which Dr. Miller presided, the newly elected president of the Association, Dr. Lawrason Brown was introduced. Dr. Brown spoke as follows:

Dr. Lawrason Brown, Saranac Lake: Mr. President, Members of the Association: It is impossible for me to express my appreciation of the honor which has been conferred upon me. I remember when this society consisted of but a small number of devoted workers. Today it is a vast organization, which is exerting not only a tremendous influence on tuberculosis, but on the public health as well. We may not have been the first national organization in the field but I think there has been no other national organization which has exerted as much influence, which gives as much promise of work in the future.

Our guide and helper in the formation of this society, Dr. Osler, in a presidential address said that the public in regard to tuberculosis was awake, was sitting on the side of the bed, was putting on its shirt. I think today that the public is nearly dressed. It may not have put on its coat yet, but many of us work better in our shirtsleeves. And I feel that way about the work of the public in regard to tuberculosis; and this work has been brought about very largely, if not entirely, through the National Tuberculosis Association which reaches now into all the states of the Union.

It has been led by able men—Trudeau, Biggs, Osler, Bowditch, Folks, and more recently by Lyman, Webb and Miller. The sheet anchors of the Association, or the men behind the guns, if you wish, have been Dr. Livingston Farrand and Dr. Charles J. Hatfield.

It is impossible at present to estimate the wonderful work that they have done. I hope all of you will clearly see that the mantle has fallen upon my shouders from such men and the task is heavy. I hope you will be patient. To continue the work, to expand it, is going to be difficult. I cannot promise to achieve it successfully, but I can promise to try.

REPORT OF THE TREASURER

Statement of Income and Expense for the Year Ended December 31, 1921

Income

1920 Seal Sale Percentage Available for work of the Association....			$153,255.06
Dues. . .			18,010.67
Donations. . .			672.10
Interest Received on Bank Deposit			1,204.40
Interest Received on Loans			2,402.44
Discount on Purchases			1,876.78
Income from Rental of Office Fixtures			8.00
Income from Motion Picture Rental			688.22
Overpayments. . .			23.21
Goods Purchased for Resale:			
Modern Health Crusade:			
Sales. . .		$43,067.85	
Cost of Sales:			
Inventory, January 1, 1921	$6,274.94		
Cost of Goods Purchased	33,871.59		
	$40,146.53		
Less: Inventory, December 31, 1921	2,049.25	38,097.28	
			4,970.57
Other Publications and Supplies:			
Sales. . .		$8,063.74	
Cost of Sales:			
Inventory, January 1, 1921	$7,556.62		
Cost of Goods Purchased	12,306.26		
	$19,862.88		
Less: Inventory, December 31, 1921	7,879.08	11,983.80	
			3,920.06
American Review of Tuberculosis:			
Income from Subscriptions		$3,897.39	
Income from Advertising		1,024.88	
		$4,922.27	
Cost of Copies Sold:			
Inventory, January 1, 1921	$6,181.23		
Production Cost	17,039.59		
	23,220.82		
Less: Inventory, December 31, 1921	$6,101.05	17,119.77	
			12,197.50
Total Income			$166,993.89

Excess of Expense over Income for the Year Ended December 31, 1921		*$7,438.56
		$174.432.45

EXPENSE

Administrative Service:		
Salaries	$25,466.31	
Traveling Expense	2,848.94	
Printing	196.59	
Proportion of General Office Expense	19,265.02	
		$47,776.86
Modern Health Crusade Service:		
Salaries	$11,300.04	
Traveling Expense	1,765.65	
Printing	152.15	
Office Equipment	30.60	
Proportion of General Office Expense	11,717.29	
		24,965.73
Medical Service:		
Salaries	$15,457.33	
Traveling Expense	1,967.52	
Printing	44.25	
Office Equipment	11.02	
Proportion of General Office Expense	7,987.00	
		25,467.12
Field Service:		
Salaries	$4,583.36	
Traveling Expense	2,070.09	
Proportion of General Office Expense	5,780.52	
		12,433.97
Research Service:		
Salaries	$7,711.24	
Traveling Expense	663.95	
Printing	149.12	
Library	100.40	
Proportion of General Office Expense	6,775.00	
		15,399.71
Publication and Publicity Service:		
Salaries	$9,653.40	
Traveling Expense	642.56	
Printing	14,742.20	
Health Clown	1,023.67	
Proportion of General Office Expense	17,747.46	
		43,809.29
Medical Research Expense		4,579.77
Total Expense		$174,432.45

*This does not include the expense of conducting the 1921 Xmas Seal Compaign. This expense being carried over to be applied against the income from the compaign, which will be received in 1922.

For list of contributors, life members and members, see page 740.

ADDRESS OF WELCOME

By the Hon. Charles E. Hughes

Secretary of State of the United States

I heartily felicitate you upon your achievement in checking this terrible scourge of mankind. It was my privilege to be associated with that part of the campaign against tuberculosis which was started in New York in 1907. It was in the following year that basic legislation was enacted providing for the reporting of cases and for sanitary supervision. I remember well the manner in which the county fairs throughout the State were utilized through lectures and tuberculosis exhibits to show the people the preventive measures which were at their command. I believe that it was in 1909 that counties in that State were authorized to establish tuberculosis hospitals. Nothing could be more gratifying than the progress that has been made since that time. According to the statistics that have been furnished me, which apply to New York State outside of New York City, the death rate in this period has fallen from 129 to 86, a decrease of 34 per cent. That means, as I understood it, that last year in that part of New York State, there were 2,700 fewer deaths than there would have been at the rate for the year 1907.

I also note the extraordinary results attained in the District of Columbia, where I understand that the colored death rate from tuberculosis is less than one-half of what it was in 1880, and the white death rate less than one-third.

Perhaps there is no better illustration of the importance of the cooperation of public and private agencies. The movement needs the aid of legislation and sound administration, but its success ultimately depends upon voluntary cooperative effort. It is with especial pleasure that I recall the work that was done in New York by the State Charities Aid Association, and there as elsewhere while the public organizations of charitable effort were of the utmost importance, it was through the constant vigilance, intelligence, and persistence of private effort that the desired results were achieved.

I am glad to be advised that this important cooperation is going on, under your auspices, throughout the country, and that what has been under my observation in New York is simply a phase of the general movement. It appears that since your Association was formed in 1905, the number of hospitals and sanatoria for tuberculosis have increased sevenfold, and that the number of dispensaries has been multiplied by twenty-four, and that the number of public health nurses has risen to ten

thousand. I understand that the death rate from tuberculosis in the registration area of the United States has decreased almost exactly one-half since this Association began its work, which means one hundred thousand fewer deaths last year in the United States than there would have been had the earlier rate continued.

The collateral benefits of this movement are of the greatest importance. I do not speak simply of the obvious economic results in the saving to the community of human resources. Rather I should emphasize the general attention to sanitation and hygiene and the corresponding advance in conditions of well-being throughout our land. You cannot attack a specific problem of this sort helpfully without aiding in the solution of cognate problems.

It is well for the community to recognize that with respect to this dreadful scourge, which was formerly regarded as a visitation of Providence, we hold the means of prevention. Early and correct diagnosis,—as to which there is still much to be demanded of the medical profession—segregation, adequate nursing,—these are the essential measures. If a plague suddenly visited us with the destructive effect of this disease, the entire Nation would be aroused to self protection. Familiarity too long dulled our apprehension. Fortunately that indifference has largely disappeared, but it is only through your constant activity that our communities will be alive to their opportunity and duty. Perhaps in no field of effort is there so much promise and opportunity as in that of conserving the public health. To those who have labored in this movement the Nation is under lasting obligation, and I trust that you will have an ever-increasing support and a constantly widening area of the most successful endeavor.

THE POWER OF THE SPIRIT

By James Alexander Miller, M.D.

New York

Address of the President

The great honor which this Association bestowed upon me in electing me its President carries with it the privilege and responsibility of addressing you upon matters of general concern to our organization.

I approach the task, as I accepted the office at your hands last year, with a deep sense of my own inadequacy combined with a sincere hope to render some service toward the furtherance of the splendid undertaking in which we are joined.

I had previously had the opportunity to know something of the general workings of this Association, but this year of special service and responsibility has given me a fuller understanding of its activities which leaves me astonished at its accomplishments and profoundly impressed by the efficiency with which the Association has been developed and conducted under the leadership of our Managing Director, Doctor Hatfield. My personal gratification, as well as a sense of common justice, renders it impossible to pass unexpressed my sincere conviction that the great success which our Association has attained is due mainly to the unremitting devotion to and the efficient and skilful administration of its activities by the permanent executive staff.

As a result, I am able to report to you that the affairs of the Association have never been in better condition than at present and that the prospects for continued success in our nationally organized effort to control tuberculosis have never been more bright.

My duties during the past year have afforded me close and most enjoyable contacts with many of the component local organizations of our Association, a consequent closer personal acquaintanceship with many of you who are the workers in the field, and a better knowledge of the actual problems with which you are confronted and surrounded.

From the multitude of these problems it has not been easy to select one of special interest and importance concerning which it might be profitable to address you upon this occasion. I have selected my present topic from a deep conviction that the spirit constitutes the mainspring of all successful action in the humanitarian field, and that in our especial sphere of action we have in the past been guided to success to an exceptional degree by the wonderful spirit which has dominated the leaders of this great anti-tuberculosis movement and which through them has permeated the whole army of its workers.

The whole world to-day, and perhaps especially our own country, appears enmeshed in a materialistic revulsion from the ecstatic emotions of the great war which could not fail to find its echoes in our own ranks. Moreover, in our peculiar field there is an added danger because of the increasing recognition of the economic and materialistic claims for the value of our efforts upon the sociological side and from the medical point of view of our dependence upon exact science, and our pride in our material accomplishments is a constant temptation to rely upon them too exclusively as the keynote to our progress.

Wonderful and fundamentally important as are these materialistic elements in our campaign, we cannot afford to dim the light which shines behind them or to forget that in movements such as ours it is the permeating influence of the right spirit which moves with power upon the lives of men.

My address to you to-day is, therefore, an appeal to cherish the great heritage of the spirit which is peculiarly ours and to develop it as our most precious asset amid the increasingly complex problems which may tend to cloud our vision.

THE SPIRIT OF SERVICE

A gathering of the members of the National Tuberculosis Association, such as this, scarcely needs to be reminded of this fundamental essential in our work. Our efforts are primarily called forth by the appeal of disease and suffering, often dependent upon social and economic inequalities or maladjustments, and are stimulated by the conviction that these conditions are preventable and unnecessary. This emotional appeal is greatly enhanced by the increasing scope of our work with children, which never fails of a ready response.

The roots of the three great professions, medicine, nursing and social service, which compose the backbone of our Association, are sunk deep into the soil of devotion to the needs of the sick and of the weak who are reaching out for the helping hand of trained and sympathetic service. It is our privilege to profit by the highest traditions and ideals of these professions, and by our responsibility, at the same time, to develop and deepen them in the sphere of our special interests.

When we pause to review the wonderful opportunities for service that are ours, in medicine, in nursing, in social rehabilitation, in the relief of poverty and distress, in the readjustment of unequal home and industrial conditions, in the protection and development of children and a host of others, the vision is a sobering as well as an inspiring one.

In such a task, no grudging, time-serving spirit can succeed. The true measure of the success of each one of us in our particular task is the extent to which we give and spend ourselves in a deep spirit of consecration to a great cause. It is thus that our movement becomes truly the crusade which it has been called.

THE PIONEER SPIRIT

We are apt comfortably to sit back in the thought that the pioneer era is past. In the sense of exploration of absolutely untouched fields of territory or of knowledge this may be true, but in a wider sense the pioneer spirit may be considered as that of courageous inquiry and action in the fields of the as yet unknown. In medicine and in public health it is the spirit of research.

The history of preventive medicine teaches us our absolute dependence upon scientific knowledge for all of the essentials of our present programme and, if we are honest and intelligent in our thinking, we are well aware that our knowledge is as yet imperfect and inadequate in many respects.

We are thrilled with pride in our pioneers in medicine and none are more notable than those in the field of tuberculosis. We owe it to them and ourselves to inculcate the spirit of research into our present daily tasks.

Reasearch is a term too loosely employed, but in its true sense it is the key to knowledge and the essential of progress. This is by no means confined to the limited field of the laboratory, but includes the entire scope of our activities, whether they be chiefly medical or exclusively sociological.

Research may be defined simply as the operation of an inquiring mind, trained to observe accurately, to note carefully and to correlate logically such phenomena as may occur in our experience, to the end that the sum total of knowledge may be extended.

To only the gifted few is given the imagination to visualize the possibilities of brilliant experiment. *All* may develop habits of study and observation in their work, the result of which may be some addition to general knowledge.

The imagination that can see visions of future possibilities in the midst of dull routine brings the fire of enthusiasm into our tasks and substitutes a spirit of restless energy for that of smug satisfaction. This involves a capacity for constant change to meet the demands of new knowledge, but change is the prerequisite of life and of growth.

THE SPIRIT OF UNITY

We Americans are apt to pride ourselves upon our devotion to cooperation and efficiency, terms which have become somewhat threadbare from overuse. The principle involved, that is, coördinated effort for a common purpose, is fundamentally sound, and the result is proper organization.

Tuberculosis Association relations: That this Association is the largest and probably the most successful of all similar voluntary organizations for the promotion of health and the prevention of disease is due largely to the sound principles of organization upon which it is based.

Following logically the existing divisions in the political structure of our form of government, we are organized upon community, county, state and national lines. Each unit has its own function and responsibility, but each depends upon the others for the full measure of success. These appear to be self-evident facts, and yet in the past few years tendencies have developed here and there which, if fostered and extended, might threaten the unity of our effort.

The greatest material asset and one of the greatest unifying forces which this Association possesses is the Christmas Seal Sale. It is unique and makes us the envied of all similar organizations. Yet it is this very seal sale which appears to be making difficulties for a few local units.

As a member of a local association, keen to develop its own work, I can well appreciate the desire to retain as large a share as possible of the funds raised, in order to develop the concrete tasks which loom large to us because near at hand, and are consequently more clearly visualized and understood. This is a natural first reaction which experience usually broadens into a realization of the dependence of local effort upon the State and National organizations of which it is a component part.

I am sure that there are few, if any, here present who have not grown into this larger point of view. The fact, however, that here and there are some who have not, suggests some flaw in our methods which demands recognition and correction while as yet no material damage is done. The fault would appear to be either that such a local unit is ignorant or neglectful of the benefits to be derived from the larger organization, or that the larger organizations have been remiss in the education of or in service to the disaffected local society. That mistakes on either side should occasionally occur is perhaps inevitable, but the best evidence that they are not vital and can be corrected is found in the recent reorganization of this Association to meet the demands for more general and democratic representation in the government of its affairs. The spirit which dominated the respective representatives of the National Association and its affiliated organizations in the conferences which led up to the recent changes in our constitution was a notable example of broad-minded statesmanship and recognition of the unity of purpose in this campaign.

Such a spirit should be in control of every local society, however small, and will, I am sure, continue to govern the actions of our National and State Associations in reference to the fundamentally important local units to an ever increasing degree.

Relations with public health authorities: The time has long gone by in this country when voluntary organizations should expect or attempt to dominate the field of the prevention of disease. This is a recognized function and primary responsibility of the public health authorities. That they are not now and probably never will be able completely to meet this responsibility is the reason for existence of associations such

as ours. In nation, state and community it is our duty and privilege to work side by side with the health authorities in a common purpose to control tuberculosis. That this is not always a simple and easy task is the common experience of us all, and from their side, no doubt, it is that of public health officials also.

It would be impossible for me, even were it expedient, to attempt to lay down precise rules for guidance in these mutual relations of public and voluntary agencies, for conditions vary widely in different communities at different times. It is perhaps allowable, however, to assume that the following principles would be generally applicable:

1. That an increasing burden of responsibility should be shifted to the public authorities in proportion to their ability to carry them and to do so efficiently.

2. That it is the function of the voluntary agency to fill out the gaps in an accepted programme left by lack of public funds or public initiative.

3. That, in addition, it may be recognized that public funds in general may not be expended for experimentation in new fields and that the function of the limited demonstration of possibly valuable new methods belongs properly to the voluntary organizations, which, when successfully demonstrated, then become a responsibility of the public authorities to be incorporated in their general programme.

4. That, furthermore, our voluntary organizations have the responsibility of collective citizenship constantly to scrutinize public health policies and to stimulate public sentiment to support and to demand those which are sound, and that this responsibility carries with it the possibility of commendation as well as criticism is a point of view which is perhaps too seldom appreciated.

5. In general, it would seem sound policy to expect that public and voluntary agencies together might profitably come to agree upon the programme for any community and allot the various features of it in accordance with the resources and personnel at the command of each.

Whether we accept some such general basis of operation as has been thus briefly outlined or not, it is evident that the success or failure of coöperative effort between public and voluntary agencies depends more upon the spirit of approach to these mutual problems than upon any fixed rule of action. The French have a saying to the effect, "It is not so much what you do, but the way that you do it." The cultivation of a spirit of mutual understanding and helpfulness is the key to happy and effective unity of effort, and perhaps we unofficial workers forget that the best evidence of our own success may be the extent to which we stimulate and assist our public agencies to live up to the full measure of their duties and responsibilities.

Relations to other voluntary health agencies: The struggle against tuberculosis is a part of a more extensive campaign against disease in general. Not only should we be glad so to dispose our forces that they

will most effectively assist toward the attainment of the general ultimate objective, the elimination of all preventable disease, but we must also recognize and give due credit to the many indirect advantages which accrue to our special interest from the activities and successes attained in other spheres of action.

Nowhere is this more evident than in our relations to the field of child welfare. We have openly and specifically claimed our interest and share in some phases of preventive work with children. We have adequate scientific basis for this claim and we are justified in it. In practical operation, however, we come immediately in contact with many other child welfare agencies, and opportunity for overlapping, if not indeed for friction, is not lacking. The very strength and efficiency of our tuberculosis movement may operate to make us the objects of suspicion. Once started upon this course, where are we to stop? Where does the prevention of tuberculosis cease and child hygiene *per se* begin?

The question is therefore raised for serious consideration whether the time has not come for a study of the possibilities of a closer union between the organizations in the field of preventive medicine and especially of those which have to do with tuberculosis and child welfare. We see beginnings in this direction in the formation of the Child Health Council and the National Health Council. In some states and communities it has gone even further in the metamorphosis of the tuberculosis associations into health associations.

Doubts are expressed as to the wisdom of these changes. The question is whether the advantages of fusion can be obtained without loss of the peculiar and special interest in the separate fields of effort. The problem is important and demands our immediate and earnest attention.

Certain it is, that it will ultimately be solved by the local communities. The sum of their experiences will mould the decision of any associations organized upon the broader basis of state or nation. Are we as individuals and as communities sufficiently alive to the possibilities involved, and are we all conscientiously thinking and working toward a solution which will best serve, not only the cause of tuberculosis prevention, but also child welfare and general health as well?

In all of these problems of coöperation involving our relations with each other in the field of tuberculosis, as well as those with other public and voluntary agencies in the public health field, we need a keen sense of the importance of unity of action, the spirit of which will level all differences and overcome many difficulties.

THE SPIRIT OF RESPONSIBILITY

Those of us of the present generation who are actively engaged in the affairs of this Association and its component organizations are in the position of trustees for a great movement with which we have been entrusted from the hands of its founders and which we must in turn pass on to our successors. The responsibility is great, just as the movement is great, and far beyond our personal interest or proprietorship in it.

This recognition of our share in it, as in the nature of a trust, places upon us definite obligations to give of our best in our temporary administration of our Association and at the same time to lay firm foundations for its future growth and development.

This responsibility appears to me to be in the main one of education and training.

Comparatively few of the present or past leaders in this movement have been especially trained for their tasks. We have grown up and into the work largely through the operation of propitious circumstances. Our training in it has been through the hard school of personal experience.

The magnitude of this undertaking and the degree of expert knowledge which its successful operation now requires, demands more thorough preparation and training for the generation which is to come on and take our places.

The anti-tuberculosis campaign has always been primarily one of education. We have played an important part in the remarkable development of public health education which the last two decades have witnessed in this country. To this phase of our responsibility we have responded magnificently and can view the future with equanimity and satisfaction.

In the training of social workers and nurses for public health work, including tuberculosis, notable progress has also been made. Even though there be many unsolved problems in the education of these groups of workers, we may upon the whole feel assured that these will be satisfactorily solved and that the near future will demonstrate satisfactory development along the lines already laid out.

In the education of medical students and physicians in tuberculosis, however, we have miserably failed and the fact constitutes a problem and responsibility of the greatest moment.

The principles upon which this organization is based and has developed are sound because our great medical leaders have made them so. Chance, fortunate for us, has thus far stricken a sufficient number of able physicians with the disease to force them into the field of tuberculosis and thus have we in the main recruited our medical leaders.

There is no systematized effort being made to attract brilliant medical minds to our work or satisfactorily to train those who may be disposed in this direction. Are we to continue to leave to the tubercle bacillus the choice of its own exterminators, particularly when our diminishing death rate leads us to hope and to expect that the number of candidates from this source will be increasingly limited?

Some of us who are physicians have watched with growing concern the tendency for health movements such as this to pass more and more into the hands of those who have had no medical training.

This is no criticism of social workers. They simply carry the banner lest it fall from the hands of uninterested or untrained physicians. All honor to them for their zeal and ability to carry on so well, but we are

in danger of losing by default a medical and scientific direction which may in time develop as a fatal weakness in our campaign.

I do not fail to recognize the importance and value of such schools for tuberculosis, which have been so successfully instituted at Trudeau and at Colorado Springs. I am also aware of fairly numerous papers and resolutions upon this subject which adorn the records of this Association, but they have thus far failed to make any but the faintest, impress upon the strategically important strongholds of conservatism, namely, the undergraduate and graduate schools of our great medical universities.

The only way to begin is to commence. An immediate and urgent responsibility rests upon those of us, who may have affiliations with any of these centres of medical education, to insist upon a recognition of the importance of the special study of tuberculosis in their curricula and to plan how the splendid equipment for practical training which exists in the dispensaries, hospitals, sanatoria and social service organizations may be coördinated with the present school facilities, so that all physicians may graduate in medicine with at least as full a knowledge of tuberculosis as our trained social workers now enjoy, and also that opportunities for special training may be offered to the selected few to whom the splendid opportunities for service in this special field may appeal.

And to all the rest of us who have no such affiliations with medical schools, there remains the responsibility for a greater realization of the fundamental importance of better medical education which would lead us to urge its adequate financial support as an indispensable part of our anti-tuberculosis programme. The large capital expenses for hospitals and sanatoria have been made in the last twenty years. There is every indication that the need for such expenditures will be increasingly less in proportion to the success of our campaign. There is no more important field into which such funds could be diverted than into that of medical training.

If in the next ten years we could pass on to the next generation a satisfactory system of medical education in tuberculosis we would have taken a most notable step toward the fulfilment of the responsibility which is ours.

What I have so inadequately attempted to express to you are but intimations of the power and influence of the right spirit in this struggle of ours to conquer tuberculosis.

But this Association and the whole tuberculosis movement in this country possess a peculiarly precious heritage which is equalled by none other and which challenges us to live up to our very highest ideals.

We have had as our founder and first leader Edward Livingston Trudeau. To me, personally, as to many others here present, it was his inspiration which first kindled and has constantly strengthened an interest in tuberculosis. This prompts me to take this opportunity to remem-

ber our obligations to his life and to his spirit, for I like to think that his spirit watches over, as his life inspired, the destinies of this Association.

In his address as first President of this Association in 1905, Dr. Trudeau said:

> On the spirit of a work like this depends its life and success. The motive which has brought you together, and the spirit which has made possible the existence of the National Association, is to my mind the best guarantee of its success; for its work represents the highest type of unselfish human endeavor and the highest aim of a noble profession; namely, the struggle for the existence of others—a struggle which will not be rewarded even by the gratitude of those whose lives you will save, for they will never even know that they have been saved.

It is now for us, seventeen years later, to assess honestly the measure in which we have kept alive and developed this spirit of which Trudeau then had the vision. It may aid us to review briefly how he met some of the responsibilities which we have just been considering.

No one more than he ever possessed the true spirit of service to the thousands who loved him as their friend and their physician. Even when losing their fight, his words brought a benediction which strengthened them to pass on in courageous peace, because his hand was in theirs.

The veritable pioneer spirit was also conspicuously his. Through it he braved the winter vigors of the Adirondack forests, to test a theory of treatment which had never before been attempted and which led to the founding of the first sanatorium in this country, the beautiful institution which bears his name. The same spirit led him later to his memorable scientific researches through an insatiable eagerness to penetrate the unknown and to benefit mankind. Nor did he fail to sense the fundamental importance of unity of effort, for in this same Presidential Address he said: "Organization and coöperation are the key notes of the age; on their thorough application and broadest interpretation depends the degree of success the National Association will achieve. The first problem before it is to combine and direct the scattered efforts of individual workers and existing associations, and to extend and expand the field of these efforts." Could we have a better definition of our present day responsibilities?

Trudeau also realized his responsibility to pass on his inspiration and his knowledge to those about him. In the physicians and workers about him he stimulated an enthusiastic devotion to the ideals which he cherished, which has made the Saranac spirit what we know it to-day and which has left few of us untouched by it.

All this, accomplished in the face of well-nigh constant struggle with his own disease, constitutes a study of bravery and achievement well deserving the wonder and admiration with which it inspires us to-day. But that by no means represents all that he means to us. It was Trudeau, the man, who gripped hard those privileged to be near him.

His frail but virile figure, the keen but kindly face, lighted so frequently with his wonderful smile, and the rich, smooth tones of his voice, so well adapted to convey the expression of his brilliant mind, combined to constitute a personality of rare charm which rarely failed to convert the first fascination into the admiration and affection of devoted friendship.

That was indeed a man! And he is ours, ours in a very special and real sense. Those of us to whom is left the responsibility of carrying on the work he so nobly began would do well to take frequent opportunity in our quiet hours to meditate on his life and his example and to rekindle our flagging enthusiasm by the fire of the wonderful spirit that was his.

At the close of another memorable address, the master voiced in words much more fitting than any which I have at my command the message which I would leave with you:

> Let us not, therefore, quench the faith nor turn from the vision which, whether we own it or not, we carry, as Stevenson's lantern bearers their lanterns, hidden from the outer world, and, thus inspired, many will reach the goal; and if for most of us our achievements inevitably must fall short of our ideals, if when age and infirmity overtake us "we come not within sight of the castle of our dreams," nevertheless all will be well with us; for, as Stevenson tells us rightly, "to travel *hopefully* is better than to arrive, and the true success is in labor."

REPORT OF THE EXECUTIVE OFFICE FOR THE YEAR ENDING MAY 1, 1922

The eighteenth year of the activities of the National Tuberculosis Association has been marked by a happy augury for the future which is of world-wide importance to the campaign against tuberculosis. It may not be too much to say that the members of the Association gathered here today can look back upon this meeting as an historic occasion without precedent in the international movement to wipe out the Great White Plague. It is an unusual pleasure to announce that in the eighteen years, since the formation of the National Tuberculosis Association, in 1904, the death rate from tuberculosis in the United States has been reduced one-half. This means a saving for the year 1921 of one hundred thousand lives. As explained in terms of death rate it means that the 1904 rate of 200 per hundred thousand persons has been reduced to less than 100. When these results are contemplated, anti-tuberculosis workers can face the future with renewed hope and with a still stronger will to redouble effort in the hope that the time may not long be delayed when the incidence of tuberculosis may be reduced to the proportions of typhoid fever and small-pox.

It is certainly gratifying to be able to report such progress in the presence of many charter members of the National Tuberculosis Association who attended the organization meeting in 1904. Surely these pioneers did not dream of any such rate of progress when they banded together eighteen years ago, and resolved that henceforth the fight against this disease should be waged on a nation-wide basis.

This announcement of the splendid results of the work of eighteen years is a tribute not only to the founders of the movement, but to the increasing number of anti-tuberculosis workers and loyal supporters of the cause who have labored unceasingly during the years. It is also a tribute to the power of public health education and to the unfailing support of newspapers, magazines, motion pictures and other mediums of reaching the general public. It is a tribute to the growing body of physicians and nurses who have become specialists in the tuberculosis field and who are increasing our knowledge of methods of prevention and treatment, and who have taught the public and the patients themselves how to fight the disease. More than all, it is a tribute to the governmental agencies, including state and local boards of health and to the great national public health movements, which have contributed so largely to the cause of public health in general during the past few years, and thus have been of direct assistance in the fight against tuberculosis. The solidarity of the tuberculosis movement itself and the enormous in-

crease in cooperative enterprises with other health movements have produced these results.

The year 1921-1922 has been filled with so many important events that it is difficult to summarize them in the limits of a printed report. A summary, however, ought to include such events as continued development of cooperative arrangements with the other national health organizations at 370 Seventh Avenue, New York City; the organization and development of the Industrial Research section of our Medical Service; the continuance of the very important services rendered by our staff members in connection with the rehabilitation of tuberculous ex-service men; the development of the follow-up study of sanatorium cases; the development of the Modern Health Crusade after the most careful consideration of recommendations from authoritative sources; the publication of a history of the National Tuberculosis Association; a continuance of the important work of the Committee on Medical Research; and lastly, a statement of vital importance as an encouragement for anti-tuberculosis workers everywhere, a reduction of the death rate from tuberculosis in Framingham, Mass., to the figure of forty per hundred thousand for the year 1921 in contrast to an average of about one hundred for the United States as a whole. In spite of the small unit of population, the shortness of the period of experiment, and the likelihood that next year the rate may go higher, still the present fact is momentous and inspiring.

It might be natural for the Executive Office of the National Association, under present circumstances, to be satisfied with the rate of progress and complacent in view of these optimistic reports. It must be stated emphatically that such is not our attitude. The Framingham figures, for instance, are indicative of what may be done under methods and programs of work which have been carried out under the auspices of a special committee of the Association. Tuberculosis workers throughout the country will join with us in being impatient for a much more rapid rate of progress when we see that the death rate elsewhere compares so unfavorably with that of Framingham; when we realize that in the United States there are still about one million persons with active tuberculosis and that one hundred thousand men, women and children are dying annually from this preventable and curable disease.

INTERNATIONAL UNION AGAINST TUBERCULOSIS

The third meeting of the International Union Against Tuberculosis will be held in Brussels July 11th to 13th, 1922. The United States will be represented by Dr. George M. Price, Mrs. E. L. M. Tate-Thompson, Dr. William M. Stockwell, Dr. Linsly R. Williams, Dr. B. S. Pollak, the Managing Director and Mr. T. B. Kidner of the National Tuberculosis Association. A paper on the community health and tuberculosis demonstration at Framingham, Mass., will be presented by Dr. Hatfield, and a paper on "Work for the Tuberculous During and After the Cure" will be read by Mr. Kidner.

At the meeting of the Union in London last year, it was arranged that after the Brussels Conference two years should elapse before the next meeting which will be held in the United States in 1924. It is a great pleasure to announce that at the London meeting Dr. Theobald Smith of Princeton University was elected to the office of President-Elect of the Union. He will take office immediately after the Brussels meeting, and will end his term by presiding over the session to be held in the United States in 1924.

The National Association was officially represented at the 1921 meeting of the Union by a special delegate, Col. George E. Bushnell, who presented a paper on "The Rôle of the International Union in the Prevention of Tuberculosis."

NATIONAL HEALTH COUNCIL

Since the removal of the executive office to 370 Seventh Avenue, New York City, which took place shortly before the last annual meeting, our Association has been housed with five other members of the National Health Council. These are the American Public Health Association, the American Social Hygiene Association, National Committee for Mental Hygiene, National Organization for Public Health Nursing and American Society for the Control of Cancer. The National Child Health Council also has established a branch office at this address. Seven of the ten members of the Council are, therefore, working together on the fifteenth and sixteenth floors of the building. The conference member of the Council, the United States Public Health Service, also has a branch office on the sixteenth floor.

The work of the National Health Council has been made known in various ways; therefore, it is sufficient to report at this time that its activities are increasing in importance and the progress made has been most gratifying to the organizations represented in its membership. Our National Association has assisted the Council in carrying out its plans for a health week under the auspices of the International Rotary Clubs. The legislative service of the Council has been made available to our affiliated associations since its establishment. The Council has recently concluded a series of weekly lectures describing the work of its member organizations and other important national health agencies. An outline of the services of the National Tuberculosis Association was presented by Mr. Hopkins. Staff members of our Association are represented on various joint committees which function under the auspices of the Council to discuss from time to time such questions as exhibits, motion pictures, statistics, library service, business administration, publications, health plays, recreation, health of employes, etc.

NATIONAL CHILD HEALTH COUNCIL

The Association has continued its membership in the National Child Health Council, being represented by the Managing Director and Mr. William H. Baldwin. In January the members of the Council undertook

a joint field study of Erie County, N. Y., exclusive of Buffalo, to indicate the advantages of co-operative action on the part of national agencies interested in the various phases of child health. Miss Whitney representing the National Association and also the New York State Charities Aid Association, spent part of the month of December, together with representatives from the other organizations, in doing the actual field work in that county. She served as statistician for the field group. A joint report embodying the findings of the field staff was prepared and is now in press.

RELATIONS WITH STATE TUBERCULOSIS ASSOCIATIONS

In the last annual report favorable comment was made on the steady improvement being shown in the organization and managment of state tuberculosis associations. Since that time further progress has been evident, and with few exceptions an effort to comply with the minimum qualifications laid down in our new by-laws has been noted on the part of the fifty-three associations that are entitled to nominate a director on the Board of the National Association provided the requirements are met and maintained.

In order that accurate information might be available, on which the Board of Directors could base a judgement as to whether or not these associations were maintaining the qualifications, a questionnaire was sent out by President Miller about the first of January. In addition to information regarding the organization of the association, the questionnaire asked for a report of accomplishments, a financial statement, an audit for the previous year, and a budget and program for the present year.

The by-laws provide that "the Board of Directors shall be the sole judge of the qualifications for affiliated and represented associations, and of their right to membership and representation on the Board of Directors." In order that the Board might have a preliminary digest of the vast amount of information received, the Executive Committee, at its meeting on March 7th, appointed a special committee of the Board to study the material and draw up a preliminary report for consideration. It was fitting that the committee consisted of the four members of the original committee on reorganization, the report of which committee was partially incorporated in the by-laws. These members were Dr. David R. Lyman, Chairman; Dr. William Charles White, Dr. Gerald B. Webb and Mr. Sherman C. Kingsley. At the request of the committee, Mr. Hopkins and Mr. Strawson have devoted considerable time to a tabulation of the data submitted.

ADMINISTRATIVE SERVICE

The staff of the Association now numbers 18 administrative members and 27 clerical members, which is a decrease of eight from the number employed the previous year, and is coincident with a reduction in the budget of the Association.

In November and December the Administrative Service gave considerable time to the preparation of a budget for the present year, supplementing the figures by an explanation of the program of the seven services and memoranda covering each item in the budget. It is gratifying to report that a more extensive study than ever before was made of the estimated resources, and of the needs of the Association for 1922, under the direction of a special committee consisting of President Miller, Dr. Hermann Biggs, and, Mr. Homer Folks. This committee together with Mr. Henry B. Platt, Treasurer of the Association, gave considerable time to the tentative budget, and later made a report which was accepted by the Board of Directors at the January meeting. Unfortunately the anticipated revenues of the Association from the seal sale were decreased by later reports, and in March it became necessary to eliminate about $10,000 from the budget. The staff of the Association has been making earnest effort to render the greatest possible service despite the curtailment that has been necessary in certain directions.

Outline of Services

The material which was first prepared by the heads of services for the information of the special finance committee was later revised, and has now been issued to the Board of Directors and the affiliated associations as an outline of the work of the Association with special reference to its 1922 program.

The accounting methods of the Association have been steadily improved throughout the year, and it has been possible for the accounting department to carry additional work with a decreased staff. The firm of accountants which made the annual audit of the books on January 1st were complimentary in their reference to the improvement made.

Common Service Committee

The Administrative Service has had the task of working out the transfer of certain functions to the Common Service Committee, which is the agency under the National Health Council to develop such co-operative enterprises as shipping, storage, telephone, multigraphing, etc. The Committee has made painstaking efforts to work out a solution of all difficulties. Up to the present time there has been little financial saving due to the new arrangement, but there is nothing to indicate that insuperable obstacles are in the way of a further readjustment so that in course of time the committee will be carrying its duties to the satisfaction of all the constituent agencies, either with decreased cost or with increased efficiency. Since this is the first co-operative health venture of its kind, time must be given to work out the new problems. Mr. Sharpe, Business Manager of the Association, made a study of the business methods of the Committee at its request early in the year and several changes in procedure have been based on his report.

Revolving Fund

The revolving fund of the Association has now been increased to a total of $21,800. During the past year there has been added to this fund a donation of $500 from the United Brotherhood of Carpenters and Joiners, Indianapolis, Indiana, the sum of $200 donated by the Connecticut Tuberculosis Commission, and a payment of $100 for life membership by our Treasurer, Mr. Henry B. Platt. It is expected that this fund will be increased shortly by the addition of a sum of about $4,000 bequeathed to the National Association by a Chicago friend, recently deceased.

MEDICAL SERVICE

There has been a great increase in the volume of work that has devolved upon the Medical Service during the past year.

Three new members of the staff have been added to this Service. Dr. Edgar T. Shields came in July to serve as Medical Field Secretary; Mr. W. I. Hamilton came September 1st as Secretary of the Industrial Research Section; and Mr. George T. Eddy, in October, as Librarian for the Section.

Co-operation with United States Government

There has been no decrease in the amount of service rendered various departments of the Government in dealing with problems of the tuberculous ex-Service men. The services of Dr. Pattison and Mr. Kidner have been in continual demand. The Committee of Consultants on Hospitalization, has almost completed its labors in allocating the $18,600,000 appropriated by the Congress for new hospitals.

Dr. Pattison and Mr. Kidner have continued to act as advisors to this Committee on tuberculosis hospitals and have been of assistance in determining the location of new hospitals; have visited many proposed sites; have inspected numerous institutions offered to the Government. They have scrutinized very carefully the plans prepared for these hospitals, and, acting for the Consultants, have offered many suggestions for improvements.

Co-operation with the Veterans' Bureau, the U. S. Public Health Service and the National Home for Disabled Volunteer Soldiers has continued.

During the recent field trip to the Far West, supplied with credentials from the Government, Dr. Pattison visited seven Government institutions caring for ex-Service men, and studied the problem of migration of ex-Service men to the West and Southwest.

Dr. Pattison appeared before a special committee of the Senate at the request of Senator Sutherland, in July, and gave testimony on proposed legislation. and also answered inquiries regarding tuberculosis and its relation to the problem of the ex-Service men.

Mr. Kidner also gave testimony at a hearing on the Langley Bill, and was called into conference with the Medical Division of the Veterans' Bureau.

With Director Forbes and Colonel Robert U. Patterson, Chief Medical Advisor of the Veterans' Bureau, Mr. Kidner and Dr. Shields went to Saranac Lake to study the problem of the ex-Service men who were being cared for in boarding houses and sanatoria in that region.

The National Tuberculosis Association was active in opposing the efforts to abolish the Reserve Corps of the Public Health Service.

Advisory Service to Other National Agencies

Last fall, Dr. Pattison accepted the appointment as Advisory Member of the reorganized National Rehabilitation Committee of the American Legion, and has continued in close co-operation with Colonel Albert A Sprague, Chairman of the Committee.

Another important service was a conference in Denver, relative to the problem of hundreds of ex-Service men in Colorado and other Western states who are not receiving compensation and have become a charge upon these Western communities.

The Medical Service co-operated with other members of the executive staff in preparing a program of sanatorium service for a special Committee of the Knights of Columbus. It appears from the report of the Chairman of this Committee, presented at San Francisco, that the suggestions offered by the National Association were accepted.

Institutional Advisory Service

The demands of the public upon this Service continue. Dr. Pattison was invited to appear at the State House in Harrisburg to consult with the State Board of Health and the Pennsylvania Tuberculosis Association concerning policies and plans for the erection of two large county sanatoria in Pennsylvania.

Mr. Kidner and Dr. Shields were requested by the Commissioners of Essex County, Massachusetts, and the Medical Superintendent of the Essex County Sanatorium to make an exhaustive investigation of the new sanatorium at Middleton. A full report on the physical plant and administration of the institution was submitted.

Mr. Kidner has spent a great deal of time in the field inspecting proposed sites for new sanatoria, advising in the construction of new units, and on the remodeling of some old and poorly arranged plants.

During the year he has visited twenty states, from Massachusetts in the North, to Florida, Louisiana and Arkansas in the South.

Arkansas has recently requested the National Association to prepare a program providing for adequate institutions for the care and treatment of the tuberculous in that state.

One of the most important consultations on sanatorium planning undertaken was at St. Louis, where Mr. Kidner spent some time on the plans

and prepared a report on the proposed new municipal sanatorium of 1,000 beds.

In Marion, Indiana, he conferred with the local authorities on a proposed county sanatorium project. This particular site was offered to the local association by a prominent citizen as a direct result of one of the articles published by *The Outlook* during the Christmas Seal Sale in 1921.

Dr. Pattison studied the proposed plans for two state sanatoria to be built in Idaho, and offered a number of suggestions for important changes in the plans.

A number of important pieces of advisory work on construction have been carried on by Mr. Kidner through office correspondence, and include studies of plans for new sanatoria, extensions to existing institutions, children's buildings, tuberculosis camps, heliotherapy pavilions, etc.

The survey of tuberculosis institutions in New Jersey undertaken something over a year ago, has been completed, and the report also nearly completed.

Occupational Therapy

The annual meeting of the American Occupational Therapy Association was held in Baltimore, October 20-22. Dr. Pattison read a paper on "The Trend of Occupational Therapy." He has been appointed one of the associate editors of *Archives of Occupational Therapy.*

During his visit to St. Louis, Mr. Kidner gave two addresses on Occupational Therapy; one before the Missouri Occupational Society, and one to the students in the St. Louis School of Occupational Therapy.

Mr. Kidner also prepared an article for the *Modern Hospital* on "Buildings for Occupational Therapy."

Other field Service

During the months of January, February and March, Dr. Pattison made an extensive trip, visiting eleven Southwest, Coast, and Northwest States.

Beside the inspection of Government institutions already referred to, Dr. Pattison spent four weeks studying the tuberculosis dispensaries and sanatoria of California, for the Division of Tuberculosis of the State Board of Health, and has submitted his report.

The Washington Tuberculosis Association was invited by the Standards Committee of the State Medical Society to have a survey made of the institutions caring for tuberculosis, with a view to classification and rating, according to the standards of the American Sanatorium Association. Dr. Pattison was detailed for this service and has his report in course of preparation.

This field trip covered 11,650 miles; visits to 14 clinics, and 34 institutions. Dr. Pattison attended numerous conferences on various phases of local and national work, and gave 24 public addresses on general and special subjects relating to tuberculosis.

Articles Prepared for Publication

Mr. Kidner prepared, last fall, illustrated articles for three of the leading magazines. Reprints have been obtained for the use of the Association. The titles are as follows: "A Small Children's Building for a County Tuberculosis Sanatorium." "The Planning of Children's Preventoria." "Notes on Tuberculosis Sanatorium Planning."

Dr. Shields prepared an article for the *Long Island Medical Journal,* which was also published in the *Texas State Medical Journal,* entitled, "Treatment of Mild and Convalescent Tuberculosis Patients with Limited Means."

Miss Marshall prepared an article on "Nursing Care for the Tuberculous" for the *Cyclopedia of Nursing,* to be published by the McMillan Company.

Dr. Pattison has prepared an article on sanatorium-home treatment to be published in the June number of the *American Review of Tuberculosis.*

Outlines of two lectures were prepared for the United States Public Health Service for use in their Public Health Institute training course on "The Early Diagnosis and Treatment of Tuberculosis," and "The Ultimate Solution of the Tuberculosis Problem."

Tuberculosis Teaching in Medical Schools

Dr. Shields has begun the work of collecting data covering the clinical and didactic teaching of tuberculosis in undergraduate medical schools. Thus far he has visited the medical schools of New York City and Yale University Medical School.

The National Association is indebted to the Public Health Service for the use of material collected from medical schools throughout the United States.

Industrial Research

At the Annual Meeting in New York last June, it was reported that the National Tuberculosis Association had been invited by the Federal Board for Vocational Education to undertake a study of the health hazards of industry as they relate to tuberculosis. It will be remembered that the Federal Board agreed to pay the sum of $10,000 a year for three years—the National Association to provide a like amount. The study was begun September first under the general supervision of the Medical Service and directly conducted by Mr. Walter I. Hamilton. The plan and scope of the work was developed and submitted to the Advisory Committee for approval. Such approval was secured and definite work undertaken. A preliminary pamphlet of instruction to vocational advisors and others interested in the subject of vocational guidance and placement of the tuberculous in industry was prepared and submitted to the Advisory Committee for approval. After very careful editing, embodying the suggestions and criticisms that were offered, the manuscript was submitted to the Federal Board. An extended analytical study of hotel occupations

has been made together with an evaluation of the findings in terms of health risks and standards. The complete report is believed to contain also information of value along the lines of vocational guidance and training other than simply the vocational training of the handicapped. Bibliographical material in the form of library cards, and typed manuscript abstracts of important articles in current periodicals have been compiled. The first payment of $10,000 by the Government has been received.

It was necessary for the National Association to seek special gifts for this work. The New York Foundation and the Commonwealth Fund appropriated $2,500 each. These sums have been paid to the Association. The staff of the Industrial Research Section for the period covered by the report has consisted of Dr. Pattison as supervisor, Mr. Walter I. Hamilton, industrial research secretary, Miss Margaret L. Muir, later succeeded by Miss Priscilla Eddy, secretary, and Mr. George T. Eddy, librarian.

Mr. Hamilton has severed his connection with the National Association to take up other work. The investigation has been considerably retarded for this and other unavoidable reasons, but is is hoped that means will be found for prosecuting with vigor this important study.

Dr. Pattison delivered two lectures on tuberculosis at the Summer School of Arts and Sciences at Harvard University in the course on vocational rehabilitation.

Sanatorium Home Treatment

The sanatorium home treatment program presented to the American Sanatorium Association was approved unanimously and carried with it the suggestion that the National Association expedite the inauguration of such a program. The program has been explained to the New England Conference, the Mississippi Valley Conference, and to numerous other groups of workers in the tuberculosis field and has been well received. A letter to the state associations carrying sample copies of the basic family charts and the patient's medical charts, with the mimeographed standards for home treatment has been sent out, and a number of organizations are anxious to co-operate in the project. Further action depends somewhat upon the financial ability of the National Association to give the necessary supervision.

Nursing Service

Miss Marshall has done a large amount of field work during the past year, having visited the training school at Trudeau Sanatorium, Saranac Lake, the Post Graduate Course for Nurses at Oteen, St. John's County Hospital, New Brunswick, attended the New England Conference at Boston, and the Mississippi Valley Conference. She also visited Trenton and Bergen County, New Jersey, gathering information on the New Jersey survey.

She has assisted in planning a program for a round table at the biannual meeting of the three national nursing organizations in Seattle. Reprints of

an article on "Education in Tuberculosis for Student Nurses" by Louise M. Powell with "Minimum Standards for Instruction," prepared by subcommittee at her request and recommended by the National League of Nursing Education, have been sent to each affiliated association with a letter suggesting methods of distribution and stimulation of interest in the teaching of tuberculosis in training schools.

She has been working on standards for dispensary and clinic records and these forms are nearly completed.

On account of ill health, Miss Marshall has been obliged to be away from the office during several weeks in February and March and at the present time is on an extended leave of absence for the same reason.

Dr. Shields has given considerable time to research work upon traveling and motor clinics, climate, class and home treatment of the tuberculous, surveys, etc.

PUBLICITY AND PUBLICATIONS SERVICE

The function of the Publicity and Publications Service is primarily to summarize and tell what the National Association is doing and how tuberculosis may be cured, prevented and controlled. This service is the eyes and ears of the Association.

Christmas Seal Publicity

The Christmas seal publicity campaign usually takes about four months of continuous activity on the part of the publicity and publications service. In August, 1921, the service sent out to about 10,000 magazines, trade journals and house organs a circular letter asking if they would co-operate in the seal sale by giving either a display advertisement, a space for an article or story, or a cover design. The response was overwhelming, so much so that the office was hard pressed to meet the demand. The amount of publicity and advertising secured in almost all of the leading publications of the country would have cost the Association, if it had been paid for, more than $100,000.

In addition to the Christmas seal publicity the service has furnished a considerable amount of material to newspapers, magazines and other publications at varying intervals. One of the most valuable routine services has been through the Foreign Language Information Bureau. By furnishing this Bureau with a bi-weekly article the Association has been able to reach practically all of the largest foreign language papers. It is interesting to note in this connection that the foreign language papers are demanding articles of a much more technical and scientific character than those requested for the English-reading public.

Other Publicity Activities

The service has helped also during the year in the development of a number of new educational ideas and has further developed some of those

already started. Hardly a day passes that the advice of the office is not sought upon questions of exhibits, posters, printed matter and other methods of graphic display. The publicity and publications service handles correspondence and conferences of this character.

Health Plays

The health plays, in which the National Association pioneered about five years ago, have been widely used but there is a general belief that the series should be revised. In co-operation with the National Health Council this work of revision is now in progress and is rapidly nearing completion. It is planned to publish a new edition of probably twenty-five plays.

The marionette idea, both in the Tiny Tim's House and in the regular standard theater, has been developed and perfected during the past year and new plays have been worked out for these interesting educational devices. As might be expected, the marionette idea, because it is more difficult of operation, has not made as rapid progress as some of the more simple and easily handled educational devices.

During the past year, in co-operation with the Modern Health Crusade Service a series of health games have been devised and perfected. These games utilize the common parlor and playground sports, applying to the ordinary mechanical devices used in "fish pond," "ring-toss," or similar games, some health slogans or health names.

Health Clown

Humpty Dumpty, the health clown of the National Tuberculosis Association, has appeared during the past year in five states. He has given two hundred and ten performances. The approximate number of children before whom he has appeared is 153,000. The National Association has spent a good deal of time and money in perfecting Mr. Law's act. It is gratifying to report that educators and public health workers everywhere in commenting upon the act have spoken of its sound pedagogical presentation and health message.

Motion Pictures

The motion picture service has steadily developed during the past year. "The Tournament of Youth," first shown at the last annual meeting, has been revised and about twenty-five prints of it have now been sold. The most popular film in the service in "Jinks," although it has been on the market for nearly five years. The gross return from the rental and sale of prints during the past year, in spite of the small charge made, amounted to $4,563.50. Against this charge, of course, must go the cost of the prints, the operating cost, etc. The motion picture trailer worked out with the publicity and publications service in connection with the seal sale last year was a great success, nearly 300 prints being sold. A similar trailer has been prepared for this year.

Publications

The publications of the publicity and publications service take about one-half of the time of the service. The periodical publications have all shown a significant and wholesome development. The AMERICAN REVIEW OF TUBERCULOSIS has at present a circulation of nearly 1,400 copies and prints about 1,700 copies each month. The increased subsciption price of the REVIEW, which went into effect on March first, has had no serious effect upon the subscription list.

Because of financial necessities, it has been deemed desirable to reduce the size of the monthly BULLETIN to a standard edition of four pages. The BULLETIN will be limited strictly to news of the National Tuberculosis Association and to pertinent suggestions regarding methods and technique. The present circulation of the BULLETIN is approximately 14,000 copies per month. It is doubtless the most popular publication of the National Association.

The JOURNAL OF THE OUTDOOR LIFE has had a successful year. At the time of the last annual meeting, the JOURNAL was in a serious condition. Its debts have now been paid and it has gradually developed into a position where the National Tuberculosis Association can with safety take over the entire control and management, publishing it as it does the REVIEW and the BULLETIN.

The annual volume of TRANSACTIONS for the last annual meeting has made a book of 677 pages. It is interesting in this connection to note that the volume for the Seventeenth Annual Meeting of 1921 had 206 pages more than the volume for the Seventh Annual Meeting, ten years previous. The editing of the volume of TRANSACTIONS takes a very large part of the time of the editorial secretary between the months of July and December.

In the fall of 1921 the manuscript for the history of the National Tuberculosis Association was prepared by Dr. Knopf. Before it could be published, it required a considerable amount of revision, addition and editing. It is gratifying to report that the first volume from the press will be on display and sale at the book table for this meeting. The book makes a volume of somewhat over 550 pages and is a valuable addition to the National Association's list of publications. The Association is deeply indebted to Dr. Knopf for his painstaking and self-sacrificing labor in the preparation of this volume.

Early in the year 1922, Mr. Jacobs began the preparation of a new book to be entitled "The Tuberculosis Worker, a Handbook on Methods and Programs of Tuberculosis Work." The first draft of the manuscript has been completed. Negotiations have been in progress for a publisher. It is hoped that the book can be issued in the fall of this year and that it will sell for about $1.50 or $2.00. It will make a volume of about 200 pages.

In response to requests from various quarters, the publicity and publications service has prepared a 32-page pamphlet entitled, "The Integrity

of the Christmas Seal," the purpose of which is to interest leaders in social and philanthropic enterprises throughout the country in the value of the tuberculosis Christmas seal as an educational and financial medium.

During the year the service has also prepared and published a new four-page circular for popular distribution entitled "Becoming Acquainted with the Enemy Tuberculosis." The circular is printed in 17 languages. An initial edition of 700,000 was prepared, but within a month it was found necessary to print an additional 250,000. The two pamphlets entitled "What You Should Know About Tuberculosis" (pamphlet No. 106) and "Sleeping and Sitting in the Open Air" (pamphlet No. 101), have been completely revised, the former by Dr. Charles L. Minor and Dr. David R. Lyman, and the latter by Mr. Jacobs and Miss Williams. New editions with more attractive covers have been printed and are now available for distribution. The service has prepared also a number of circulars of various kinds.

Membership

The membership of the National Tuberculosis Association on April 1st was 3,415. This indicates a slight falling off from last year, but in view of the general financial condition of the country and the fact that the Association has been unable to make an extensive membership appeal, the entire list appears to be in a very healthy condition. The publicity and publications service has been greatly interested in efforts to raise additional revenue for the Association and has assisted in approaching foundations and other groups to this end.

Institutes

Following the annual meeting of last year, the first post-graduate institute was conducted by Mr. Jacobs. This institute was attended by thirty-one executives, all of whom had attended some previous institute or had had definite administrative experience. The enthusiastic comment of those who attended the course would seem to indicate the desirability of holding further courses of this character. A regular institute was conducted in April of this year by Mr. Jacobs and attended by twenty-one pupils. This is the tenth institute conducted by the National Tuberculosis Association. All told, 274 people have attended these various sessions.

One of the purposes of the book on tuberculosis methods is to extend the institute idea in all parts of the country, utilizing this book as a textbook. The institute idea for training of tuberculosis workers is gradually developing in favor.

MODERN HEALTH CRUSADE SERVICE

The development of the Modern Health Crusade in the last five years has two phases: first, general promotion throughout the country, with

spontaneous extension into foreign lands; second, adaptation to the varied needs or policies of the schools and the tuberculosis associations. Marked progress has been made in the latter phase during this last year.

Crusade Material

In the preparation of Crusade material two distinct and opposed lines of demand have been encountered. The first, aiming at thorough incorporation of the Crusade into the school curricula, has called for publication of the chore record in several editions for advancing grades; for handbooks giving detailed suggestions for courses in hygiene under the Crusade system in all elementary grades; for books of health stories, songs, etc., etc.; in short, for the elaboration of Crusade material. The first demand is for school standardization of the Crusade.

The second demand, in the name of simplicity, is to reduce the amount of Crusade material. It calls for but one chore record, for whatever grade it is used, and for a procedure that will require the minimum of time, attention and expense.

Fortunately a way has been found to meet both demands. It lies in making the *requirements* of the Crusade extremely simple and in the clear representation that everything else recommended is purely optional.

The Crusade publications now prepared for the school year 1922-23 make it clear that all that is required in the Crusade is: (a) The performance of health chores to a minimum number for a minimum number of weeks. (b) The systematic recording of the performance of chores. (c) The award of chivalric titles earned by performance. Everything else in the Crusade is optional.

Schools may set number of weeks for the performance of chores, provided it be not less than 12. At least 24 weeks in a school year are recommended. The schools may award the chivalric titles in any way they think best. The use of the Roll of Health Knighthood and of buttons and pins, while recommended, is left to the discretion of school authorities.

The use of only one set of chores is required. On the other hand, it is recommended that different sets of chores be used, graded progressively. The National Association is publishing the chore record in graded editions designed for the third, fourth, fifth and sixth grades but is in a position to fill orders either for one chore record for various grades or for the four graded chores.

It is recommended that Crusade chores be taught from the kindergarden through the second grade but in lieu of printed chore records that the children make their own pictorial records and otherwise receive training through the project method. For the seventh and eighth grades the program of the Crusade Round Table and work in community sanitation are recommended.

In further recognition of the two contrary demands, simplicity and elaboration, the executive office has prepared different circulars of

instruction to teachers. The "brief" explains the operation of the Crusade as limited to requirements. The manual sets forth also the optional features recommended to schools.

Conferences

In its constant study to adapt the Crusade to varied needs the Association has been well served by advisers. Conferences have been held in New York, Chicago and Washington between representatives of the National Association and the following groups: The National Council of the Modern Health Crusade, the Committee of the National Council of State Departments of Education (National Education Association), the Committee of State and Provincial Health Authorities of North America, and the Committee of the secretaries of state tuberculosis associations. The last committee, consisting of Mr. Faulkner, of the Georgia Association, Mrs. Grant, of the District of Columbia Association, and Mr. Edmonds, of the Iowa Association, have given their time generously in correspondence, travel and protracted conferences with Mr. DeForest, Miss Osborne and the Managing Director. We wish to acknowledge our indebtedness also to members of the National Council; to the Committee of State Superintendents, Mr. McClenaham, of Iowa, Miss Neilson, of North Dakota, Miss Redfield, of Idaho, and Mrs. Preston, of Washington; and to the Committee of Health Authorities, Dr. Kelley, of Massachusetts, Dr. Rankin, of North Carolina, and Dr. Crumbine, of Kansas.

The Crusade in the Curriculum

The Crusade system has now been introduced as a curriculum activity by the departments of education of fifteen states. The Crusade is either made mandatory or is recommended for adoption by local school systems. In many other states, county or city school systems have placed the Crusade in the curricula. It has been adopted as a system based on *practice* in distinction from precept. It is, we believe, the only practice system yet devised capable of adoption on a wide scale. The adoption of the Crusade, however, does not discourage informative instruction in hygiene or physiology.

It is gratifying to note the number of state departments of education that are publishing teachers' manuals incorporating the Modern Health Crusade. Such states are: Maine, Vermont, Alabama, Mississippi, Indiana, Iowa, Kentucky and Ohio. The Crusade Directors of several of the state tuberculosis associations have been employed in the preparation of these manuals, and Miss Osborne, while doing field work for the National Association, was able to serve the North Dakota Department of Education in this way. The Ohio "Course of Study in Hygiene," written by Miss Virginia Lewis, Crusade Director of the Ohio Public Health Association, makes the Crusade the motif for the course from the first to the eighth grades.

Course in Hygiene

The purpose of the National Tuberculosis Association has not been to develop the Crusade as an organization but to contribute it to the schools as a system practicalizing instruction in hygiene. In view of the movement to incorporate the Crusade in the state manual for teachers, the National Association decided to write a course in hygiene based on the Crusade and to offer it to the state departments of education as a guide in preparing their manuals. The pressure of work of our Crusade service makes it impossible for members of the staff to devote the time required, but through the generous cooperation of the Iowa Tuberculosis Association we were able to secure the services of its Crusade Director, Miss Theresa Dansdill, for three months. The crusade course of hygiene now in preparation will be offered to the state educational authorities in manuscript form. It may also be published jointly by state departments and the National Association.

Nutrition

During the last two years the executive office has been exchanging ideas with pediatricians and especially those prominent in nutrition work for school children, regarding the service that the Crusade could render in the campaign against malnutrition. A plan has been developed by which a Crusade course for the special benefit of under-nourished children can be added to the Crusade system, which, of course, has been directed chiefly to the problem of the normal child. Mr. DeForest has written a nutrition edition of the Crusade chore record, and a circular of instructions to teachers and nutrition workers. It is found that the weight chart for the individual, used in nutrition work, combines very simply with the scoring chart for chores. More than thirty persons whose experience and position should make their opinions authoritative, including a committee appointed by the National Child Health Council, have been consulted regarding this new printed matter. It is our plan not to tie up the nutrition work of the Crusade with any one of the "schools" of nutritionists to the exclusion of the good points in other schools. Care has been taken to avoid controversial points on diet and technique. Our object has been to increase popular attention to nutrition, to make the highly practical machinery of the Crusade available, and to stimulate also the use of the best publications on nutrition by various authorities. The importance of close medical supervision is emphasized in the Crusade nutrition material. Special nutrition clinics and classes are recommended for children requiring special medical observation.

The nutrition edition of the Crusade chore record and a special circular of instruction to teachers and nutrition workers are now in type. Preliminary orders for more than 40,000 copies of this material have been received. We expect to be able to fill a large demand for this material at the opening of the next school term. With this nutrition material there is no intention, however, to displace the Crusade work for the majority of children who are not "malnourished."

Millions Enrolled

During the last year the National Association has sold 6,000,000 pieces of Crusade material. As a number of the state associations print their own material, the total volume of educational publications circulated under the Modern Health Crusade is extremely large. More than twenty-four million chore records have been used since the first chore record was published. In requisitioning supplies the state associations have responded in a very gratifying way to our request that all orders be placed with us by specified dates twice a year, relieving the National Association of the responsibility of carrying a stock.

Tournaments and Contests

Great interest has been shown in the Crusade tournaments and the silver cup contests. In the two tournaments decided since the last annual meeting 233 banners and pennants have been won by the schools in states ranging from Maine to Texas and Idaho. The inter-state cup, which was held the previous year by Iowa was won by Idaho. The inter-city cup was won by the District of Columbia. In this connection President Harding gave the Crusade notable recognition by formally presenting the cup to the school authorities of Washington. In his address of presentation he expressed great interest in the anti-tuberculosis campaign.

Field Work

In field work for the Crusade during the last year Miss Osborne made addresses and conducted institutes on Crusade methods for teachers and health workers in Ohio, Indiana, Iowa, Nebraska, North Dakota, Montana, Colorado, Utah, Idaho, Oregon and Washington. Due to shortage of funds it has been necessary to discontinue field work for the Crusade. Although Miss Osborne's connection with the National Tuberculosis Association has been discontinued, we wish to express our appreciation of the valuable services she has rendered.

Miss Louise Strachan has been employed as Assistant Crusader Executive, in place of Miss Terry, who resigned December 1st. Miss Strachan has had extensive experience in health work following her college graduation. She was the Crusader Executive for New York State and Assistant Sales Manager for the Christmas Seals. She relieves Mr. DeForest of a large part of the correspondence connected with the Crusade and also serves in writing articles and in public speaking.

The Crusade service has co-operated with the National Child Health Council and its committees. Time has been given for a number of conferences.

In reporting the progress of the Crusade mention should be made of the endorsement and thorough co-operation given the movement by the National Education Association and the National Congress of Mothers and Parent Teacher Associations and the General Federation of Women's

Clubs. The growing interest in the Crusade is evinced by the hundreds of letters received at the executive office coming from many foreign countries as well as all parts of this country.

STATISTICAL SERVICE

During the past year the personnel grouped under the heading of research, statistics and library, which was known as the Research Service, has been re-grouped under other services. Miss Towner, the Librarian, was taken over by the Common Service Committee for the joint library, and Miss Conklin, who had been doing editorial work, was assigned to the Publicity and Publications Service. Miss Whitney's title was changed from "Research Secretary" to "Statistician," and a separate Statistical Service was organized under her direction.

Sanatorium Follow-Up Study

The Sanatorium follow-up study, which was inaugurated in the Spring of 1921, required the entire services of one person, and Miss Dorothy E. Wiesner was added to the Statistical Service staff in June, 1921, to do this work.

All the sanatoria in the country were asked to co-operate in this study, which sought to determine the mortality of patients after leaving the sanatoria, their physical condition, if living, and their economic status. Over 100 sanatoria agreed to co-operate, but only 57 actually did so, returning to us their records.

The number of patients discharged from the 57 sanatoria number 8,817, and returned cards have been received from 3,500. The tabulation of this material has involved a great deal of detailed clerical work, and has necessitated the addition of temporary clerical help. A preliminary report of the results of this follow-up study was presented at the meeting of the American Sanatorium Association, held in connection with this meeting.

Miss Whitney's field work for the National Child Health Council has already been reported. Mention of her Cleveland study will be included with a later reference to the Committee on Indigent Migratory Consumptives.

Statistical Information Supplied

The Statistical Service last year prepared, from data submitted from the various registrars, a table showing the tuberculosis death rates in every state for which data were available during the past ten years. Copies of this report were sent to all state secretaries.

The Statistical Service is responsible for preparing and checking up all figures used by the other services of the National Tuberculosis Association, especially the Publicity and Publications Service. This routine function is becoming of increasing importance, as it not only safeguards the statements made, but oftentimes provides additional information of value.

Requests from the field are constantly received for specific statistical information, which is prepared by this Service.

Realizing the value of graphic presentation of the facts about tuberculosis, the Service is now preparing a series of charts showing certain phases of the tuberculosis problem. Copies of these are on exhibition at the annual meeting, and it is possible that if there is sufficient demand reproductions of them may be made for wall charts.

1921 *Mortality from Tuberculosis*

Although complete figures for the registration area in 1921 are not yet available, we have the figures from the Metropolitan Life Insurance Company for that year, and also some advance figures from a number of the states. The decline in the tuberculosis death rate in the experience of the Metropolitan Life Insurance Company was 16½ per cent. from 1920 to 1921. If the same decline was manifest in the registration area, then the rate of 114 for 1920 would fall to approximately 95 in 1921. Probably the decline in the registration area will not be so marked as that for the Insurance Company.

Figures already received from over half the states in the entire country give an average death rate for tuberculosis in those states of 93. From these figures we feel safe in assuming that with complete figures available for 1921 the tuberculosis death rate will not exceed 100.

Surveys

The survey is coming more and more into use, and requests are constantly received for help along this line. Miss Whitney's services in making surveys have been promised to two associations during June and October, and it is to be regretted that more of her time is not available for work of this character. Miss Whitney has written a short article entitled "Suggestions for Making a Tuberculosis Survey."

Statistical Conference Group

Under the National Health Council a statistical conference group has been formed, consisting of Miss Whitney and the statisticians of the National Committee for Mental Hygiene, and the American Social Hygiene Association. This group acts as an advisory committee on statistics for the other member organizations that have no statistical service. It is hoped that the work of this committee may later on indicate the advisability of forming a larger statistical organization under the National Health Council.

FIELD SERVICE

Field Trips

Since the last annual meeting the Supervisor of Field Service has accepted invitations to do field work in 64 cities scattered through all

regions of the United States. This has taken him to 34 of the 53 Affiliated and Represented Associations.

In 19 states one trip was made; in 8, two trips were made or cities visited; in 1, three trips were made or cities visited; in 4, four trips were made or cities visited, and 2, five trips were made or cities visited.

In addition to aid in the Seal Sale to many state and local associations, the Supervisor of Field Service made a seal sale organizing trip through all the northwestern states, in response to a request for aid.

Constitutions

During the year aid was given also to more than a fourth of the state associations in the revision of their constitutions, in order to make the organization more efficient and in compliance with the requirements of the new by-laws of the National Association. The Field Service has been at all times equipped with a model constitution for state and local associations. As occasion required, the constitution has been modified to meet the needs of the particular associations.

Consultant Service

Consultant service was furnished thirty-eight of the affiliated associations by eighteen consultants, who gave service in sixty cities. The number of addresses given in each city is always recorded as one, since we have no complete record, but the office has knowledge that it varies from one to four.

These figures cover only the use of consultants arranged through the national office. The state associations were given lists which have been revised from time to time. How much use the associations have made of the consultants on this list is not known to the National Association, as they frequently and properly arrange service independently of the office.

The Executive Committee of the National Tuberculosis Association has appointed official consultants in the following lines of work:

Accounting.
Christmas Seals.
Clinical Tuberculosis.
Co-ordination.
Dispensaries.
Industrial Medicine.
Institutional (Hospital and Sanatorium Construction).
Local Programs.
Medical Education and Research.
Medical Field Service.
Nursing Affairs.
Nutrition.
Occupational Therapy and Vocational Training.

Open Air Schools.
Publicity.
Sanatorium Administration.
Speakers to Lay Audiences.
Speakers to Medical Audiences.
Surveys.
Statistical Studies.
Tuberculosis Laboratories.

Aid to State Associations

An important part of the field work has been to acquaint state and local associations with the services of the National Tuberculosis Association, which are too often quite unknown or not understood. This has incidentally resulted in much helpful data and additional service being given to such associations through our Modern Health Crusade, medical, institutional, tuberculosis nursing, publicity, statistical and administrative services. It also provides the Executive Office with data helpful in planning its work.

Employment

During the ten months from June, 1921, to March, 1922, inclusive, co-operating with the American Association of Social Workers, placement in tuberculosis positions was made as follows: Educational secretaries, 8; executive secretaries, 6; field clinician, 1; field workers, 2; medical man in tuberculosis school, 1; occupational therapists, 2; public health nurses, 18; sanatorium superintendents, 4; sanatorium social workers, 3; total, 45.

Special advertisements for workers and positions were placed in space contributed by the Journal of the Outdoor Life, and occasional lists of candidates were sent to all state secretaries. This involved carrying an average of 25 open positions monthly, the making of 88 recommendations and the writing of 68 letters per month by the American Association of Social Workers, as well as considerable correspondence and many interviews by members of the National Tuberculosis Association staff.

Community Chests

A study of financial federations and their effect on tuberculosis work was made, in co-operation with the Publicity Service, for the benefit of and on the request of the state executive secretaries. A continuing study is being carried on, with data supplied on request to executive secretaries of both local and state associations in all regions of the country.

The attitude of the National Tuberculosis Association and its policy in relation to community chests appears in the report above referred to, as well as in the new pamphlet of the Association, entitled "The Integrity of the Christmas Seal." They are briefly as follows: 1. Preservation of the Christmas seal idea. 2. Conservation and development of the local

campaign against tuberculosis. 3. Recognition of the claims of the state and National associations, since tuberculosis is an inter-state problem. 4. Recognition of the place of the non-official health agency.

Negro Health Week

The National Tuberculosis Association was invited by the United States Public Health Service to co-operate in the promotion of Negro Health Week, held April 2 to 8, 1922. To this end, Dr. L. B. McBrayer acted as special representative of the National Association at a conference in Tuskeegee, Ala., where plans for Negro Health Week were developed. The Field Service of the Association, assisted by the Publicity and Statistical Services, gave special help to the state and local executives in working out the plans.

CAMPAIGN SERVICE

According to the latest reports, the total income from the seal sale for 1921 will reach $3,500,000, or a reduction of approximately $157,000 from the seal sale in 1920. In this connection it is to be noted that the decrease in returns does not represent a serious loss in funds available for tuberculosis work, as the national, state and local associations have been able to reduce expenses in conducting the seal sale during each of the past two years to an extent sufficient to effect a total annual saving that may be safely estimated at $100,000.

Field Work

More than four hundred orders for seal supplies were filled during the summer months of 1921, and during the latter part of the year the Campaign Service, both by correspondence and field work, to which several members of the staff were temporarily diverted, gave all the assistance possible with our limited budget to aid the state associations to organize their sale of seals along satisfactory lines.

Seal Supplies

Following this, and while local seal agents were still engaged in the sale of Christmas seals, the Campaign Service began in December, 1921, to make arrangements with artists for designs and advertising material for the seal sale for 1922.

During the past fourteen years the expansion and development of the seal sale throughout the United States has progressed to such an extent that the problem of providing the necessary supplies has become a considerable business in itself. It involves the purchase and distribution of approximately $15,000 worth of printed matter, including nearly a billion seals and large quantities of posters and other advertising material.

Advisory Committee Helpful

Early in January the Advisory Committee for the Christmas Seal Sale, appointed to represent the affiliated associations, met with staff

members of the Executive Office to discuss plans for improving the campaign service for 1922. Mention should be made of the excellent work done by this Committee. With their assistance great improvement has been made in the artistic and advertising value of the seal, posters and other printed matter and many suggestions have been offered that will be helpful both to the National and state associations.

Under the advance schedule followed this year the affiliated associations received samples of all supplies during the early part of April and they have been allowed sixty days in which to submit the final orders to the Executive Office. This is an important and helpful arrangement and will serve the double purpose of stimulating the state associations to begin earlier to plan for the next seal sale and of providing ample time for them to submit samples to their local seal agents and secure orders for supplies.

Need for Further Organization

Judging from a recent study made by the Campaign Service it seems apparent that sixty per cent. of the states are still in the pioneer stage of development. In such states a considerable rural area, representing a large number of counties, has not been effectively organized. This emphasizes the need for more intensive effort in promoting the seal sale. As a preliminary step, the Executive Office conducted a Christmas Seal Institute for state executives here in Washington last Monday and Tuesday, and it is hoped that the state associations will arrange similar meetings to train their local seal agents in organization and publicity methods for the seal sale. In support of such a program several members of the Executive Office staff will be available to render advisory assistance in the field during September and October. Also an effort is being made to secure funds from outside sources to finance additional field service for states in which the seal sale has suffered most severely during the past two years.

All things considered, the financial outlook for 1922 is decidedly hopeful. With improving business conditions our state associations will be encouraged to think in terms of more ambitious local programs of work, which will undoubtedly be reflected in an increased return from the seal sale.

Plans for 1923

Profiting by the experience of this year, the Campaign Service is making a still further advance in the schedule for supplies. Arrangements have been made with an artist of international reputation who, in collaboration with an art committee in New York and members of the Advisory Committee, will shortly submit a series of sketches for the Christmas Seal for 1923, and other artists are working on the posters and other advertising matter to be included in the supply list for 1923.

TUBERCULOSIS DIVISION OF THE JOINT LIBRARY

The library of the National Association was taken over by the Common Service Committee soon after the office moved to its present location. It was combined with the libraries of the American Social Hygiene Association, the National Organization for Public Health Nursing, and the National Committee for Mental Hygiene. After the amalgamation was tested out it was decided to continue the plan and if possible to secure funds for the entire maintenance of the joint library. Pending the receipt of such funds, it is necessary for each of the various agencies to continue the support of the work.

The tuberculosis section of the library has been developed until it now plays an important part in the work carried on by the various services. Under the present consolidation much classifying and analyzing of material has been done by the cataloguers. The consolidation has also made available the books of more general character bearing on the field of tuberculosis. The library now has an active department of extension work which is planning, in co-operation with members of the National Association staff, to communicate with public libraries throughout the United States recommending material and offering advisory service.

SPECIAL COMMITTEES

Committee on Community Health and Tuberculosis Demonstration

The Framingham Community Health and Tuberculosis Demonstration continues during the present year, the sixth year of the Demonstration. While the Demonstration is maintaining all of its essential contacts, it has nevertheless materially reduced its budget. This has been made possible by the taking over, on the part of local, official and voluntary agencies, of very nearly all of the practical services originally established or developed by the Demonstration itself. In this connection, it is significant to know that the community is spending now about $2.15 per capita per year, in contrast to the original 40 cents per capita per year being expended for all kinds of health work at the beginning of the Demonstration period in January, 1917.

The results to date, as measured particularly by the tuberculosis mortality rate in 1921, were most gratifying. Beginning with a rate of 121 per one hundred thousand as an average for the pre-demonstration decade (1907-16), the rate, carefully corrected yearly since 1907 for resident and certification errors, has shown a gradual though consistent decline. After five years of intensive work, the rate for 1921 was 40 per one hundred thousand, a reduction of about two-thirds under the pre-demonstration standard, a reduction both in degree and rate not equalled in any known community in spite of the striking declines which have prevailed quite generally throughout the country. In marked contrast to this Framingham decrease of 67 per cent. is the very modest decrease of 18 per cent., as shown by the seven control towns used throughout the Demonstration as a basis of comparison in Massachusetts.

The work continues to be financed by contributions from the Metropolitan Life Insurance Company, and it is probable that on a diminishing basis, a continuing period of observation over two or more additional years will be justified and indeed necessitated. This seems necessary not only from the point of view of mortality observation, but also to give great accuracy and substance to the many very significant preliminary findings as to sickness incidence, ratio of cases to deaths, hospitalization facilities necessary, etc., upon all of which problems Framingham experience has thrown unprecedented illumination.

Committee on Indigent Migratory Consumptives

At the 1921 annual meeting the Committee on Indigent Migratory Consumptives passed a resolution urging that some large city of the east or middle west be chosen as a control city, and that a study similar to the ones made in the southwest should be undertaken in that city. Cleveland was suggested. In accordance with this resolution, the National Tuberculosis Association, in co-operation with the Anti-Tuberculosis League of Cleveland, undertook this study. Miss Whitney spent the month of January, 1922, and part of February in Cleveland getting data from the various health agencies. That material is now being tabulated and the report will be available directly after the annual meeting.

The findings in Cleveland will give added emphasis to the data from the southwestern cities, and the entire report of the Committee, including the Cleveland material, will be published in pamphlet form within a few weeks.

Committee on Mortality From Tuberculosis in Dusty Trades

The final report of this Committee has now gone to press. It includes a study by Dr. Frederick L. Hoffman in regard to the economic and social factors involved, and a medical report by Dr. E. R. Baldwin, based on physical and x-ray examinations. These reports will be published by the U. S. Bureau of Labor Statistics. Copies should be available during the summer.

Committee on Medical Research

The Committee on Medical Research, under the chairmanship of Dr. William Charles White, has continued its study of the various fields of research which could be aided materially with small amounts of money. On recommendation of the committee the budget of the Association this year contains an appropriation of $12,000 for medical research. Disbursements have been continued for the work started in 1921. Those participating in the studies undertaken by the Committee will report at a joint meeting of the clinical and pathological sections on Saturday of this week.

Colonization Committee

During the period of the last annual meeting the Colony Committee met two or three times and submitted a preliminary report.

At the first session of the Committee there were present a number of men and women who had had considerable experience in the treatment, training and placement in employment of tuberculous persons. They gave their opinions as to the feasibility of various employment projects.

The complete report of the Colony Committee, which was prepared by the Medical Service, comprises 102 typewritten pages.

Arrangements were made for a meeting of the Committee on May 3rd, immediately preceding the meeting of the National Association.

Committee on Tuberculosis Among the Indians

Under the direction of the Committee, a questionaire has been sent out to state boards of health and tuberculosis associations in states having Indian reservations. Dr. Kober, Chairman of the Committee, will report at this meeting on the information gathered by the Committee.

Committee on History of the National Tuberculosis Association

The Committee on History of the National Tuberculosis Association has completed its labors with the publication of the volume of history which has already been reported in the list of publications issued during the past year.

OPPORTUNITIES FOR FURTHER SERVICE

In addition to the report of work done, it may be well to point out some of the special work that the Executive Office believes should be undertaken or further developed without delay. In the face of great opportunities for service, it is disappointing to find it necessary to state that our only reason for deferring a start on these desirable undertakings is a lack of sufficient funds.

In the expectation and hope, therefore, that a recital of these needed extensions of work will be of assistance, I wish to call your attention to the following:

Rating of Sanatoria

1. A proposed rating scheme for tuberculosis sanatoria as drawn up by the American Sanatorium Association at the suggestion of the National Tuberculosis Association has been before us for consideration for two years. It was the recommendation of the Sanatorium Association that the rating be done by the National Tuberculosis Association. Because of lack of funds it has been impossible to make more than a beginning, although the desirability and urgency of an attempt to improve the standards of sanatoria under the auspices of the sanatoria themselves is recognized. Estimated cost, $10,000 a year for several years.

Home Treatment

2. The plan for the standardization and supervision of home treatment of tuberculosis patients, as outlined by the Medical Service of the

Association, has not yet been tried out in any community. It is hoped that in the near future several experiments of this character will be started, but the supervision of staff members of the National Association is needed so that the work will be carried out according to plan, and also that accurate observations may be made of the merits of the plan with a view to modifications. Estimated cost, $3,000 a year for at least two years.

Industrial Research

3. At the request of the Federal Board for Vocational Education, a study of the health hazards of industry was undertaken in September by the National Association, as already reported. Unless further funds are secured shortly, it will be necessary to abandon this work or to maintain it on such a small scale that it cannot be completed for several years. The study as it has thus far progressed indicates, we believe, that its discontinuance would be a very great misfortune. Estimated cost, $20,000 a year for three years.

Follow-Up Study

4. Our follow-up study of sanatoria cases, the first effort of its kind to ascertain, on a large scale and over a period of years, the progress of patients after leaving the sanatorium, has been curtailed on account of lack of funds, and it has become necessary to refuse to accept data from additional sanatoria desiring to benefit by the study. A few of the interesting results of the study already apparent will be reported on at this meeting, but the possibilities have just begun to be realized and a fund is needed for continuance and development for at least another three years. Estimated cost, $4,000 a year.

Surveys

5. The Statistical Service should be expanded so that additional surveys can be undertaken in various states and local communities. The demand for this type of service has been much greater than we could meet during the past year. This is one of the most valuable types of field service because it provides basic data on which the future tuberculosis work of the community can be determined. Estimated cost, $6,500 a year.

Field Secretary

6. For two years the executive office has reported the need for at least one additional field secretary. The demand for general field service continues, the requests being for a great variety of help. During the past year the Supervisor of Field Service has been able to answer only a portion of the calls. Estimated cost, $8,000 a year for salary, travel and incidental expense.

Crusade Development

7. A fund for the development of the Modern Health Crusade is urgently needed. At present the Crusade supplies required for use in

the schools are purchased on order from various states and communities, but practically no money has been available for the promotion of the Crusade in its national aspects. Money is needed for national tournaments, contests in health essays, posters, essays, etc., and for other national projects promoting the solidarity of the movement. The promotion of national features of the Crusade is of very great importance to unify the movement and to give all localities the benefit of the experience of the whole country. Estimated cost, $7,500 for the first year.

Printing fund

8. A fund of at least $5,000 is needed for the production of printed material to be sold at cost. Each year the Association provides a large amount of material for free circulation, but it is recognized that there is a growing demand for publications which, on account of the initial expense, cannot be issued free of charge. Such a fund, therefore, would be in the nature of a revolving fund, the money received from the publications to be returned to the original fund as they are sold. Publications of this character, which the Association is having difficulty in financing, include new directories of sanatoria, tuberculosis associations, dispensaries and traveling clinics; a revised edition of our pamphlet on dispensary methods and procedure, which is now out of print; a revised edition of our pamphlet on the effect of tuberculosis institutions on surrounding property, etc.

Field Service in Seal Sale

9. A fund which can be used to provide additional field service to our affiliated associations preceding and during the Chrismas seal sale is needed. This fund would provide much more than field service in a mere money-raising campaign, because the campaign itself is an educational effort primarily, and must be based on a showing of accomplishments during the preceding year and on a program and budget of work for the coming year. The development of the plans for the seal sale, therefore, is intimately concerned with the development of right methods of tuberculosis work, and also with the best methods of educating the community as to the work already accomplished and the needs for the future. Estimated cost, $15,400 for the year 1922.

Development of Institutional Service

10. The further development of the institutional advisory service. Among the various possible features of such service the following would be widely useful: (a) The preparation and publication of a book on the details of sanatorium construction. (b) Advisory and consulting service on sanatorium accounting and all that pertains thereto, with the preparation of a model and standard system. (c) Advisory and consulting service on the furnishing and equipment of sanatoria and other institu-

tions, and the preparation of model and standard lists and specifications. (d) A study of the personnel requirements for modern sanatoria of various capacities. (e) Further study of institutional provisions for children, such as open air schools, preventoria, summer camps and children's units in sanatoria. Estimated cost, $10,000 a year.

Training and Placement of Personnel

11. The personnel problem of tuberculosis organizations and institutions of the United States is a serious one and needs more adequate study and development. Associations, dispensaries, hospitals and other agencies are suffering for lack of the right kind of personnel. The problem divides itself into three phases—training, placement and standardization. The National Association can contribute greatly to the training and placement of workers in the tuberculosis field. It can co-operate with the workers themselves in developing higher professional standards. To do these things, however, requires additional funds for the conduct of institutes, for the extension of the employment service and for definite research that will tend to develop a higher professional status on the part of tuberculosis executives. Estimated cost, $6,000 for first year.

Accounting Advisory Service

12. The development of an accounting advisory service for our own Association and for our affiliated associations is needed. It is realized that there is a tremendous field for an advisory service in budget-making, in the proper preparation and presentation of financial statements, and what would be termed in the business field a system of cost finding. We know too little about the actual cost of the various phases of our work, and furthermore, the amount that should be spent on such activities, as already worked out by other associations. There is a vast amount of material along such lines that can be made available. This would mean the employment of an expert on accounting who would familiarize himself thoroughly with the procedure in the executive office of the National Association, the relationship between the office and the affiliated associations, and a thorough study of the best business methods to be followed by state and local associations. Estimated cost, $7,000 a year.

CONCLUSION

In conclusion I wish to express to the members of the Association my personal appreciation of the loyal service rendered during the past year by all members of the staff. With cuts in budget to be arranged for on two separate occasions, with disappointments as to service and sudden calls for emergency work, the staff has proven equal to every demand placed upon it. It is no small gratification to be able to state to the Association that it has in this staff the most loyal and efficient and smoothly working organization that I personally have ever known.

Announcement was made yesterday of my resignation as Managing Director after a service extending over eight years. I take this opportunity to express to the Association my sincere pleasure and gratification in the development of the work and also in my associations with the many devoted workers who have brought about this development. I am happy in the consciousness that you will have Dr. Linsly R. Williams as my successor. You already know of Dr. Williams' experience and abilities and you will soon know more of his many fine qualities. I congratulate the Association on securing Dr. Williams as its chief executive, and I look forward with confidence to a future that in accomplishment will far exceed the past.

Respectfully submitted,

CHARLES J. HATFIELD,
Managing Director.

ADVISORY COUNCIL

Chairman

WILLIAM F. SNOW, M.D.

NEW YORK

ADDRESS OF WELCOME

By Hugh S. Cumming

Surgeon General, U. S. Public Health Service

It is a particular pleasure to welcome the members and delegates of the National Tuberculosis Association. I prize very highly this opportunity to say a few words to you because your activities are so intimately related to those of the U. S. Public Health Service.

Many of you have at various times been quick to point out that the prevention of tuberculosis is dependent upon the prevention of other communicable diseases, upon the betterment of industrial and living conditions, and upon the advancement of general sanitary measures. All of these are matters which deeply concern every agency charged with health responsibilities. Moreover, in your resolution addressed to me at your last annual meeting, in which you suggested a more careful physical examination of immigrants for tuberculosis, there is further proof of our common interest in matters vital to the public health.

After the war, as during it, your Association and its members gave invaluable assistance to the Government. Upon the return of troops from France, when the Public Health Service was required in a serious emergency to provide medical care for large numbers of disabled veterans, you were asked for aid and counsel. Both were freely given. Your Advisory Committee, which was appointed to assist us, consisted of Col. George E. Bushnell (Retired), Dr. Edward R. Baldwin, Dr. Kennon Dunham, Dr. Henry Hoagland and Dr. William C. White. These gentlemen laid down fundamental guiding principles for the care of tuberculous veterans which have been made a vital part of our program.

In all parts of the United States skilled assistance has been constantly needed in making more than a million physical examinations of claimants for military compensation. The attending specialists for this duty and for hospital consultation work in the specialty, have been supplied from your membership. Your Institutional Secretary, Mr. T. B. Kidner, was assigned to assist us in the preparation of standard plans for tuberculosis hospitals. Your Supervisor of Medical Service, Dr. H. A. Pattison, and others who represented you, have at my earnest request gone freely into our hospitals to make inspections and to assist in the proper standardization of treatment. Their criticisms have always been constructive and practical. They have not hesitated on occasion to stand between the Government and unjust censure. They have been impartial and fearless and at all times helpful. The summer training school in the sanatorium at Oteen, N. C. was initiated at the suggestion of Dr. Hatfield and others with whom he is associated. Your Secretary for Nursing, Miss Mary E. Marshall, gave practical assistance in the training of the nurses who

were included with physicians in that school, which, it is hoped, will be made an annual event.

During all the trying times which ended only last week, when by Executive Order of April 29, 1922 the President transferred to the U. S. Veterans' Bureau the operation of veterans' hospitals, your association has been a very present help. For the generous measure of your assistance I take this opportunity to express the highest appreciation.

The National Tuberculosis Association is unique in that it comprises not only physicians and nurses but many other professional and non-professional men and women. Social workers, statesmen, lawyers, teachers, dramatists, actuaries, clergymen and philanthropists are all included in your organization which is highly representative of the most altruistic, and at the same time the most practical force engaged in constructive public health work. Among your thirty-five hundred members are men and women from every part of each state in the Union. With all national affairs therefore, especially those relating to the medical functions of the Government, your interests are fully identified.

Many of those who founded this Association only eighteen years ago are no longer with us. They were ripe in years and judgment when with clear vision they moulded this efficient instrument for a comprehensive and worthy purpose. But you have at all times been well led. You have never lacked and do not now want for men, high-minded men who live not too far above the clouds to devote themselves with singleness of purpose to your tasks. I cannot at this time recall a single individual of note with interests related to tuberculosis who has not been identified with the work of this Association.

A tremendous factor in education, you have stood for adequate hospital and sanatorium care, the tuberculosis ward in general hospitals, adequate training of physicians and nurses, early diagnosis, the reporting of disease and the protection of children from infection. The improvement of industrial and housing conditions is a monument to your efforts. The routine introduction of the sleeping porch and an actual change in the prevailing style of dwelling house architecture are in no small degree due to your activities. Pure milk, the open air school and adequate recreational facilities have been fostered by you. The Health Crusade, which has taught sanitary habits to more than a million children each year, is the direct result of your initiative.

To keep abreast of the rapid developments in your chosen field you have wisely modified your program, as changing medical opinions made inevitable, from time to time. Your association has become a reservoir of information, a melting pot of research and opinion, a crucible wherein knowledge has been refined and standardized.

I am proud to give you welcome and to congratulate you as members and delegates upon the achievements of this magnificent organization in which you must all feel a pardonable pride.

The Chairman: I think I may say on behalf of all of us that we are especially appreciative of this careful statement from our Surgeon General with regard to his judgment as to the work which the Association has endeavored to do in the last eighteen years of its existence and may be expected to do in the future.

I have one regret tonight, especially as I look over the audience and see so many of the older members of the Association here. I have to announce that Dr. Vincent became ill yesterday, and is unable to be with us this evening, but we are to have the great privilege of hearing from Dr. Vaughan, one of your former Presidents, who knows much about the world problems as the layman views them and far more from the technical and scientific point of view. Dr. Vaughan needs no introduction, but perhaps some of you have not known that at the present time he is giving very generously and very successfully of his time to research, as chairman of the Medical Section of the National Research Council. We have asked Dr. Vaughan to lead up to President Farrand's statement about volunteer organizations and co-operation, by a presentation graphically, as he knows how to present things, of a picture of the present world problems of preventive medicine. Dr. Vaughan.

WORLD HEALTH PROBLEMS OF TODAY

By Victor C. Vaughan, M.D.

Ann Arbor, Mich.

I am doing something tonight that I ought not to do, and I am perfectly aware of it. I should not try to stand in another man's shoes. The last time I did this, I received a very severe rebuke. In 1915, when the American Medical Association met at San Francisco, we decided to have talks upon public health subjects. We didn't know how many people would come so we picked out a room in the great Community Building in San Francisco, and I was to talk for fifteen minutes, first, and then Dr. Mayo, General Gorgas, Dr. Flexner, and a number of others. The room was crowded and the overflow filled another room across the hall. When I finished my little talk I was asked to go into the other room and address the other audience. Unconscious of the sad fate that awaited me, I went.

After my habit, I saw a handsome woman on the front row and I went up and sat down by her. Someone got up and said, "Just keep your seats; Dr. Vaughan will be over here in a few moments and he will talk to you." This woman turned to me and with a great deal of contempt in her face she said, "I didn't come here to hear Dr. Vaughan. I came here to hear Dr. Mayo."

"Well," I said, "I agree with you perfectly in your discrimination between the two men. Dr. Vaughan is old, homely and short and stubby. Dr. Mayo is a perfect Apollo."

At about that time someone came in and said, "Is Dr. Vaughan in the audience?" I arose and told the woman that I thought she had better retire.

Then the idea of trying to fill George Vincent's place! Now, George Vincent is the only man in the world so far as I know whose intellectuality keeps pace with the rapidity of his talk. So you musn't expect either rapid fire or great effectiveness tonight.

I was much disturbed along in 1920 and thereabouts because I wanted to know what the effect of the World War had been upon our enemies, the Germans and their allies. In 1920 the International Health Board sent a representative through Europe and I made a special request that that representative should send me or furnish me information concerning the effect of the war upon the Germans and their allies. Now, I have never seen this in any of the public prints and I thought it would be interesting. This was a report, I say, made early in 1920 and the report was based upon an actual examination of the death rates in the countries visited, and I think I will read it to you.

In the first place, the population of Germany, comparing its present territory with the same section of the former empire, increased during the

war. The population in 1910, exclusive of Alsace-Lorraine and other ceded provinces, was 58,859,857; the population including the plebiscite areas, in 1919, according to minute, careful, official estimate was 59,667,729. There was an actual improvement in infant mortality in Germany during the war.

In twenty-six of the leading cities, with the single exception of Frankfort, the annual death rate per one thousand children under one year of age decreased; and the average annual rate for the twenty-six large cities of Germany as a whole dropped from 153 in 1914 to 119 in 1919.

While the tuberculosis rate in Berlin increased during the war, the rate of increase was much less than in the large cities of the German Allies. The death rate from tuberculosis in Berlin increased 52 per cent. from 1913 to 1918, but dropped 12 per cent. in 1919; while the increase in Vienna for the same period was 65.7 per cent. and in Budapest it was 87 per cent.

In Vienna the birth rate per one thousand dropped from 19.1 in 1912 to 7.6 in 1918, and 13 in 1919. The death rate in Vienna increased from 15.4 in 1912 to 20.4 in 1918 and 22.1 in 1919.

In Poland the birth rate of 36 per 1,000 before the war dropped to 11; that is, the birth rate in Poland dropped from 36 per thousand in 1912 to 11 per thousand in 1918. In the same country the death rate increased from 20 per thousand before the war to 24 per thousand in 1918. In Warsaw, for every 100 children born 73.1 persons died in 1913 and 364 in 1918. This does not refer to the Army.

In Vienna, for every 100 children born 86.4 persons died in 1913 and 167 in 1918.

In Budapest for every 100 children born 74.4 persons died in 1913 and 203 in 1918.

The German civil population did not suffer from marked increase in death rate but the allies of Germany—Poland, which was a part of Germany of course when the war began, and Austria—did suffer very severely.

I thought that it might be interesting to give you a few very brief statements concerning the present conditions of the infectious diseases so far as we are able to learn them in Russia. I should in speaking of the subject give you my authority. Don't tell anybody, but my authority is from that defunct organization—the League of Nations, which somehow or other continues to operate. We receive at the Research Council regularly reports on the health conditions in Russia from the League of Nations, the sanitary officers of the League of Nations.

Asiatic cholera in 1920 and 1921 spread along the Volga. For some reason which no one seems to be ready to explain, the Asiatic cholera did not spread far west of Kazan and other places along the Volga. Some say that the Russians stopped the spread of the cholera and others say that Providence stopped it. You can take your choice. I receive as Chairman of the Division of Medicine in the National Research Council every now and then a very earnest plea for medical aid in Russia. The League of Nations reports first a thing we know; that the United States Government last fall gave to the Russian Government four millions of dollars of medical supplies, and Dr. Kellogg of the National Research

Council told me that he saw last fall 130 carloads of this go into Russia. The League of Nations, the reports up to March last, says that the public health laboratories in certain cities in Russia are well equipped, well managed and are operating efficiently.

The League of Nations reports that the two diseases which have devastated Russia since the war are typhus fever and relapsing fever; the one a fairly deadly disease and the other causing but little mortality. The last report made by the officials of the League of Nations states that during 1920 and 1921 there were 30,000,000 cases of typhus fever in Russia. There are no official—at least *I haven't any*, probably General Cumming may have—and correct statements concerning the death rate in Russia. Of course, a great many of these people who are dying from typhus fever and succumbing to relapsing fever are really dying from starvation.

Typhus fever is, our reporters say, a condition which no one can expect to relieve entirely so long as the people are so poor, half starved at best, and living under the frightful conditions of poverty to which they are subjected at the present time.

I had a letter a few days ago from a Russian official and he said, "It would be nonsense to talk of sending any large number of American medical men to Russia now because interpreters would have to be supplied and the distances in the country are so large that many of the people must necessarily starve to death."

A great deal has been said about the possibility of the invasion in this country, through Russia, of the plague. It seems to be nothing that we should worry about so far as I am able to ascertain.

Malaria has spread rather unexpectedly and to a scarcely believable extent. There was a great deal of malaria during 1920 and 1921 along the Volga and in 1921 it reached the Arctic Ocean. It is rather strange that malaria should be rampant,—the first time I think in the history of the world where malaria has become apparently evident on the Arctic Coast. Of course, these advances of malaria have probably been in part due to the fact that the people haven't any quinine and they are not able to adopt other preventive measures to any great extent.

So far as tuberculosis is concerned the countries suffer from tuberculosis in exact proportion to the injury done to the people by the war. The worst conditions under which they have to live, compared with those under which they lived before the war—and we who have been in that country know that many of them were bad enough before—have increased the tuberculosis death rate. How soon it will begin to decrease, we don't know—probably soon.

Turning to our own country, I will say just a few words in a general way. Understand, I am not talking especially about tuberculosis. In the first place, I want to correct an erroneous impression which I think is prevalent in this country.

When I was in the Surgeon General's office at the beginning of the war, a number of articles came in, sent in by the editors of newspapers and the editors of journals, magazines, written by people who were extolling the superior health administration in Germany. At that time the editors of these newspapers and journals hesitated, of course, to publish those

articles, and some of them at least were sent to the Surgeon General, and it was my duty to answer them. I want to say it is a fact, which the records will show, that at no time in the past or present has the health administration of the German nations equalled that of the English-speaking nations. The death rate in Germany before the war never fell as low as it did in the United States and in Great Britain. The English-speaking people have always led the world in sanitation and in the improvement of the living conditions of the people.

Our death rate, apart from great epidemics of influenza which came upon us, is getting down to an almost unbelievably small figure. Within the last thirty years, the death rate in New York City, for instance, has been reduced from over 20 per thousand (the annual deaths) until now it is between 11 and 12; and in one of the large cities, according to official figures—Detroit—the death rate last year was 9.6.

Now, I want to say that that isn't true. The Federal Census gives us very unreliable figures. You can't get anything from the Federal Census in fact, or in truth. I know about the death rate in Detroit because beginning in 1910, they took the census of 1910 and then for each year figured out how much Detroit ought to grow, don't you see? And they calculated the death rate accordingly. So when 1920 came around Detroit ought to have been, according to the Census Department, a city of 600,000; it was a city of 1,000,000. So for the 1921 statistics they figured that Detroit ought to be a place of one million and several hundred thousand. The truth is that Detroit has lost several thousand since the war. It is not as big as it was in 1920, when the census was taken.

Sometimes people talk and they say that all these methods that have been followed by the present generation in reducing the death rate and so forth have all been fogy and the past generation didn't know anything.

Well now, suppose we have reduced the death rate from 20 to 13—and that has been done in practically all the registration districts—in a population of 100,000,000 that means the saving of 700,000 lives annually, doesn't it? Sanitarians, I suppose, won't agree, and probably no two of us would agree as to the possible limit to which the death rate may be reduced. I should say from what little knowledge I have of the subject—it may be a wild guess—that living as we are today under present day conditions, it is a feasible thing, a goal not unreasonably far distant when the annual death rate in this country could be reduced to 7 per thousand. Now, if we can take it down from 13 in the registration area to 7, that will mean the annual saving among 100,000,000 people of 600,000 lives.

There is more, however, to it than that and while we may at present be compelled to use our mortality statistics, there is a deeper and a bigger and a better question to it than that.

A wise Frenchman said, I think about 200 years ago—I don't remember just when Descartes lived, my history is sometimes a little off—but he said, "If the human race is ever brought to a reasonable degree of perfection it will be done by preventive medicine." I think that we are demonstrating that in this country.

But I say there is a bigger thing than simply prolonging life and we must look at it from that standpoint and that is to make the years that we live more worth living and more effective. Many a man lives to be

seventy—I have reached that age myself, that isn't anything to brag about, you know. But I ought to be a more perfect man at seventy than I am. Many a cripple lives to be fairly old but most of us go through these years, whether they be many or whether they be few, halting, lame (not necessarily in the feet or in the legs but lame sometimes in the head and sometimes in other places). We ought to be free from this and it is the purpose not only to prolong life but to make a better life of the years that we do live and I am sure that the National Tuberculosis Association with its various branches and its local effective organizations is doing great things in this direction.

There is one thing more I want to say and then I will stop: The American Medical Association, I think (I won't say it positively) intends some time in the very near future to start a medical journal for the intelligent layman, not only a health journal, but a journal where the scientific fundamentals of medicine will be presented to the intelligent laity. The trustees have promised this but I know men sometimes go back on their promises; you know there may be some hitch in it. But the caring for the health of the people is too big a proposition for the medical profession alone to carry and there are many who are without professional training who are quite as efficient today in bettering the conditions under which we live as is the doctor.

The time must come very soon when every legally qualified physician in the United States whether he lives in New York or in Podunk shall have the facilities with which to make his examination and treat his patients. This is the aim of a law which in 1910 first passed the Iowa legislature and which in some modified form has since that time passed in 31 different states, enabling any community to tax itself and build a hospital.

We have come to the point, my friends, when preventive and curative medicine must go hand by hand in the elevation and uplift of our people.

Chairman Snow: It is really an inspiring prophecy Dr. Vaughan holds out to us as to what may be done if we continue to perfect our ways and means of accomplishing this steady campaign against death and ill health.

I suppose I should introduce the next speaker as President Farrand of Cornell University, but those of us who have been gradually drawn into public health work by Dr. Farrand perhaps more than by any other one man, will never think of him except as one of the pioneers in all of the work of developing these ways and means which we have been using and are to use. In fact, I think we should exact of Cornell a promise not to interfere seriously with Dr. Farrand's continued participation in public health work. So far, he has been able to do this, and so, instead of introducing him as the President of Cornell, I want rather to introduce him as Chairman of the National Health Council.

THE ORGANIZATION OF VOLUNTARY AGENCIES FOR ADVANCING HEALTH CONSERVATION

By Livingston Farrand, M.D.
Ithaca, N. Y.

I feel myself very much at home here in this National Tuberculosis Association, although it is the first time in some years that I have had the privilege of being with you at an annual meeting.

I am a bit embarrassed to know how to take up the subject which has been assigned to me to discuss tonight. I find myself, as I stand here, in a decidedly reminiscent mood and I can't help thinking of the early days of this Association when we were groping about to discover methods that would stand the test of experience, when we had not very much to go upon except theoretical knowledge beyond those facts that had been discovered in the laboratories, and when we watched with the utmost solicitude the results of every step that was taken.

I am also tempted to turn aside from my main topic because I couldn't help having my imagination fired by the remarks of Dr. Vaughan. Anyone who has been dealing in these last years with the health situation in Europe, whenever it is alluded to, finds himself immediately immersed in that stupendous problem. Dr. Vaughan's speech offers an infinity of texts upon which to speak because the experiences of the European countries during the war and during these years since the Armistice have offered all sorts of absorbingly interesting problems in public health and have thrown a great deal of light upon the problems and methods with which we are dealing in this country.

There is one overwhelming consideration which should challenge the attention of the entire civilized world today, so far as the health situation of Europe is concerned, and that is the problem of the undernourished, underfed, underdeveloped child, and there is nothing else that can be compared with it in significance. It isn't as if we were dealing with a phenomenon that had appeared only for a year or for two years. We must remember that this is 1922 and that these conditions have existed over the greater part of Europe since 1914, and the consequence is that we have practically an entire generation that is undernourished and underfed and underdeveloped. And that lack of development unfortunately is not confined to the physical aspect, but carries with it the nervous and mental stigmata which are inevitable. So what the world is facing in Europe is an undeveloped generation—and that the only generation to which we may look to carry the civilization of the world after the next fifteen or twenty years.

The first signs of hope that we have seen in that situation have appeared during the last eight months. Mass starvation ceased some time ago except of course in certain districts of Russia. But it has been only within a few months that we have begun to see any return approaching the normal in the general nutrition of the Central European child.

What we have got to do is to pick up the slack, so far as the world is concerned, as expressed by European civilization, pick up that slack that gathered during the war, and it is no small task. It is a task that is not going to be accomplished in a year or five years or ten years. It is a matter of an entire generation, if not more; and it is a task which, as I say, should challenge the attention of the entire civilized world including this country.

The danger, as Dr. Vaughan rightly points out, is not from epidemics such as typhus. Enormous as the prevalence of typhus is today in Russia according to the reports from the League of Nations, that is an easily controlled situation. It is nothing that need cause us apprehension. But what we have got to look forward to is a Europe with a devitalized population, and that is a very serious thing for us.

However, that is not the topic upon which I was instructed to speak to you. Our first duty is always to deal with our own house and put that in order, and everybody knows that we have many problems of public health which call for attention within our own borders.

It would be idle for me in this Association to make any appeal to you to attend closely to the conditions which this very organization was brought together to fight. What we are to discuss is the means of dealing with them and what I am asked to cover particularly is the role of the unofficial agency, of the voluntary agency, in this fight.

At the risk of discussing the obvious, it seems to me it is sometimes well to assess fundamental values from time to time and be perfectly certain that in the active operation of either our personal or our association life we do not lose our perspective. We must keep our feet on the ground and not become so absorbed in method that we forget fundamental principles. Those of you who were present in the first years of this Association will remember how we finally groped our way out to a certain formulation of principles; and there was one great principle that emerged, and yet one of which I think we sometimes lose sight. That principle is that the ultimate responsibility for the protection of the public health of the nation is an *official* responsibility.

To my mind whenever a private organization confuses its function to the extent that it consciously or unconsciously reaches out and takes on an official or an administrative function, or tries to, it is distinctly out of its field. Ninety-nine times out of a hundred it is doing more harm than good. And unless that goal is always held up, I say, the Association is making a profound error in its procedure.

Secondly, we should never forget that the great fundamental purpose of the voluntary organization is, broadly speaking, public information; it is public education; it is the education of the people by every legitimate

means to a knowledge of certain fundamental facts. If you analyze the history of this Association right through these years you will realize that its successes and its methods have been developed in efforts always directed toward that end.

As one of the great features and means of public education there is nothing better or more striking or more convincing than a demonstration, and consequently as one of the primary methods of operation of a voluntary organization we find that principle of demonstration, so that the public can see a practical expression of the best knowledge and the best thought that medical science has produced.

The reason why the voluntary organization must do this is, of course, because the public official has not yet the means in hand or the public support behind him to enable him to make the demonstration or to expend the necessary funds. The very purpose of the demonstration is to create the public opinion that will give him that support. In other words the voluntary agency is always looking so to develop its field that the public will take it over and it itself can retire from action. That day has not yet been reached.

An immense impetus has been given to this whole health movement by the war and the developments since the war. There was even before that a growing interest, in the question of public health and the building up of public vitality. As a consequence there grew up, modeled I think it is fair to say—you and I can make allowances for a certain pride of organization—upon the methods that were established and demonstrated by this Tuberculosis Association, a number of other activities dealing with specific problems of public health.

Tuberculosis happened to be the great cause of death which stared people in the face and was recognized by every one. But it wasn't very long after 1904 and 1905, when this organization came into being, before people began to realize that the whole problem of infant mortality and child mortality offered a menace which was just about as striking, and was inextricably tied up with the tuberculosis problem; and so we saw an organized movement for the prevention of infant mortality. We began to get local organizations at various points and then came into being a national organization, and unfortunately not only one, but two and three and four and five organizations for dealing with this or that phase of child health. We had to begin to differentiate betwen the prenatal problem and the infant, and the pre-school age and the school age, until we got into what was a real confusion.

Then there came the great problem of venereal disease and under the able guidance of Dr. Snow there was built up a committee, later an association, on social hygiene, which has marshalled an enormous energy.

Along with it arose great interest in mental hygiene, and the appreciation by the people of the fact that a large amount of mental disability is entirely preventable brought about an organization to deal with that problem.

Encouraged by the success of these different movements we saw the organization for the control of cancer coming into being, and a large number of minor organizations, all of them directed against preventable causes of disease, and all of them worthy, but at the same time inevitably producing a certain confusion in the public mind.

For years we have realized that the aim of these organizations was practically the same. I don't think there is one of them—unless possibly it is the Society for the Control of Cancer, where we have an unknown cause—that is not built upon practically the same basis and method. Even the cancer campaign is simply one of education.

Recognizing that the methods were more or less common, the problem really that has been staring us in the face for the last few years has been the problem of coordination of these movements in such a way that we could get the added energy that would come from united action.

I have very little patience with wasting much time on the discussion of so-called overlapping. That is obvious but exaggerated as to its importance. There is in reality very little overlapping. There is, however, a very great loss of energy, by dispersion of effort, and what we are driving at is to obtain the mass energy that would come from common action. We have not yet been able to see the way to bring about the complete fusion or amalgamation of these societies because after all we are all human beings and every one of these groups is attached to a particular, specific interest, and there is little tendency to advance very far in the way of giving up either prestige or privilege or field. The consequence is that there have been many friendly gestures, there has been a good deal of encouraging talk, but there has been very little in the way of actual coming together until these more recent days.

I don't hesitate to say that in my judgment the most important single step in the way of gaining this united action has been taken in the last two years by the organization of the National Health Council, which Dr. Snow will describe in a few moments. In bringing that about we were met at once by the problems of certain of the constituent groups. For example, in order to gain proper representation of the societies dealing with child health there was organized a Child Health Council, and thus were brought together the leading agencies concerned primarily with that particular form of mortality and disease. I am very glad to say to you that the experience of the last year and a half in the child health field has been most encouraging for those societies are now working in very close harmony. They are working with compared and agreed upon programs; they are working in such a way that each turns over to the other those particular pieces of work which the other organization is is best fitted to handle, and there are signs that a still closer union is rapidly being brought about.

With these coordinations and the future unions, which are inevitable, there will be a great impetus given to this whole public health movement. There is no question, Dr. Vaughan, that the mortality rate can be reduced

to the 7 that you picture. I don't think anyone is quite bold enough to say what the limit of the reduction can be. We have seen and we have welcomed and we have almost accepted as commonplace the increase in the average length of life that has already been produced in these more recent years. We are appalled sometimes at the increase in the diseases prevalent in later life, but this is rather inevitable, I presume, if we insist on increasing the length of life and on reducing the mortality in earlier years. But what we certainly have is a most inspiring outlook for the future.

I have but one appeal to make to this society, which has been the leader in this whole movement. I would impress upon you this single fact: the very fact of leadership in the public health campaign carries with it grave responsibility. This society has been noted for demonstration of method; it has been notable for demonstration of effectiveness; I believe it has found the soundest method of organization that has yet appeared. I am inclined to think that it will be largely through this society that the future amalgamation of the health movements of the country will be brought about.

The only appeal that I have to make to you is simply to remember that there is an ideal before this National Tuberculosis Association which is greater than the eradication of the disease which it is organized to fight. This ideal is the welfare of the American people, and through them, of the world, by the building up of their vitality. That may call for a certain yielding of privilege which has been rightfully won; it may call for a recognition of the rights of certain other groups, but that a closer union is to take place is absolutely certain. It will not be tomorrow but it will not be in the distant future, and the agency which I think is most actively and most surely pointing the way is the National Health Council which has recently come into being.

My friends, there could not be a more inspiring opportunity than is today presented to us. The signs are more encouraging than they have ever been. We have never before had at our disposal demonstrations such as that at Framingham which we could use with the American people. Other demonstrations are now being made and will be made in the immediate future even on a broader and a more striking scale. We have the means at our disposal. The responsibility is yours and mine—that we make use of them.

THE NATIONAL HEALTH COUNCIL

By William F. Snow, M.D.

New York

Dr. Farrand has referred to my presentation to you of a statement with regard to the character and purposes of the National Health Council.

In order that we might very briefly picture to you the purposes, without going into details of the work the Council has done, I have taken the liberty of having distributed through the seats of the auditorium a letter-head of the Council, which has on the back of it the members and general organization, and on the front of the sheet some of the activities which have been carried on in the past year.

I should like to emphasize two or three points by way of introduction to a discussion of its organization: In the first place, it is not a new organization, that is, it is not another one added to the fifty-seven varieties that were already existent. It is the outgrowth, as President Farrand has indicated, of a feeling on the part of the directors of the organizations he mentioned and a good many others that something must be done to assure ourselves, and the general public, that there is no serious avoidable loss of effort or overlapping. President Farrand was the first chairman of a conference group some ten years ago assembled to consider what could be found by a field study. That was made by Professor Selskar Gunn and a report was issued which is very interesting, but nothing practical came out of it. Again in 1919 a further study was made at the suggestion or at least under the auspices of three organizations, the American Red Cross, the National Tuberculosis Association and the American Public Health Association. These three were practically a sub-committee of the 37 organizations which originally came together and authorized this series of studies.

The American Red Cross agreed to finance a much more careful study of all these volunteer agencies than had hitherto been practicable, and that study was made by Dr. Armstrong, who had had a long experience in making such studies and in directing the Farmingham Demonstration, which has been referred to.

This report of Dr. Armstrong's was practical, clearly summarized the situation, and definitely brought out the opinion of the directors of the larger of these organizations that something should be done. Just about a year ago, in December, I think, of 1920, a final conference was held under the auspices of the Red Cross, as host, and it was decided to be wise to begin an experiment, this experiment being the establishing of the National Health Council. Those of us who have watched it closely believe that it will go on and be called a demonstration. We are even

optimistic enough to believe it may in time come to be called a practical and successful demonstration.

It has as the basis of organization a very simple charter which gives organizations membership. At the present time there are ten member organizations. I want to analyze those by way of supplementing what President Farrand said; grouping them so that you may see how this experiment began I will put first the American Public Health Association and the Conference of State and Provincial Health Authorities of North America. You know the history of those two organizations, the Public Health Association being the oldest of all of our volunteer agencies, having influenced through its personnel so much of the work of the trained professional health workers and sanitarians of this country. The Conference of State and Provincial Boards of Health is a volunteer organization of the official State health officers of this country and of Canada, and they constantly, as you know, come in touch with the Surgeon General of the United States Public Health Service to confer on our outstanding health problems. Those two were used as a nucleus of professional interest and guidance in the field of public health. To that group were added the National Tuberculosis Association, as the oldest and the largest and most influential of the volunteer special interest societies. The American Social Hygiene Association came next as dealing with another outstanding communicable disease problem, the venereal diseases. Related to these two organizations are a good many social and economic and moral agencies which find unofficial opportunity to express their views on health matters. The National Committee for Mental Hygiene, which has quite a different field and yet one that is equally important, not only to this generation but particularly to succeeding generations, and the American Society for the Control of Cancer, were added to this nucleus. Then the Child Health Council which has been mentioned, and which in itself includes an affiliation of a very large number of participating agencies was included, and the National Organization for Public Health Nursing, which I think everyone has now come to see has a very distinct and important role to play in the application of ways and means that may be worked out by these other agencies. Finally to these were added the Council on Health and Public Instruction of the American Medical Association, as the agency which has the most ready access to the rank and file of the trained medical profession of this country, and the American Red Cross which similarly has the most direct and ready access to the lay public interested in health conservation throughout the entire United States.

All of these have been arranged administratively like spokes of a wheel about the United States Public Health Service as an advisory member for the purpose of bringing the Federal Government very closely in touch with this group of volunteer agencies.

Now, these ten were chosen as I have said for the reason that they represent different lines of activity. There are other agencies, like the Cardiac Society, and a good many others that will doubtless in time find it helpful to their work to join in this arrangement as it progresses from a small experimental organization to an assured place among our useful administrative agencies.

As to its officers, it has a chairman and a vice-chairman, a treasurer, a

recording secretary and a chairman of the membership committee, a business committee, and a paid executive officer and small staff.

It was financed in its first year by generous contributions from the American Red Cross; in its second year by a smaller contribution from the Red Cross, dues of $1,000 and less per year from the member organizations, and by three of the foundations which are interested in this experiment being given a thorough chance.

I want to speak for just a moment of the Common Service Committee, which has an independent existence but is closely correlated and really a part of the Council machinery. Before doing so I want to say the basis of organization and of procedure of the Council is that no member organization by reason of membership in any way loses its indentity or its autonomy, its independence of action, or of inter-action with any other member of the Council. Everything is acted upon around a council table by general agreement. It has already become a precedent that if any one organization has serious doubts about the success of some proposed project the others feel it to be wise to lay that project on the table until more data are at hand and unanimous action can be looked forward to.

Regarding the first year's work I would say in passing that the Federal Legislative Reports and the State Legislative Bulletins have both been of great assistance. As a single illustration of what has been done: Each one of these agencies and many others have in the past had to arrange in Washington for information about bills presented to Congress that related to their respective fields. They found it difficult to get accurate information, to get it promptly and to keep informed as to the trend of developments. Now they get this service through this Bureau. This bureau of the Council is not a propaganda agency in any form; it is merely an informing agency to keep closely in touch with not only legislation but administrative acts of the Government with regard to health conservation. There are some three or four hundred names now on the lists for the federal bi-weekly reporting service. In the State legislation work the United States Public Health Service and the State Health Officers are co-operating in gathering the information, and the Council is issuing it in a separate bulletin series.

Field studies on State and local organization have been of great help to a number of the organizations and these studies are bound to be of increasing value.

The Common Service Committee, to which I have alluded, has begun a demonstration of what may be accomplished by putting the principal organizations of the Council under one roof. Propinquity has a good deal to do with the give and take of everyday life and of interchange of individual views; and this is true of organization staffs.

The Common Service Committee is merely a machinery for assuming the burden of landlord for all the organizations, for handling the common services that have developed, that is, shipping and accounting, multigraphing, purchasing, printing—no organization goes into these services further than the extent to which its own personal interest leads it. The library is a good illustration.

Four of the large organizations, Tuberculosis, Public Health Nursing, Mental Hygiene, and Social Hygiene—have pooled their libraries and also have transferred their librarians to a common library staff with advantage

to all four agencies. For example the Extension Librarian is reaching out now for all of them into the libraries of the country. There are over 2500 libraries of some importance in this country. The objective of the Council and the Committee is to get on the shelves of these libraries gradually by suggestion a standard selection of good books, and to get off their shelves the unsound books.

As to the future, I think I may say that the idea is steadily gaining ground that it is possible to use the machinery of the Council as a common distributing agency and clearing house for aiding the stimulation of extension work in territories for which it is now rather expensive to keep field secretaries for each organization.

I think perhaps it is fair, since Dr. Hatfield instructed me to serve as Chairman this evening, that I should retaliate by asking him to make an extemporaneous concluding statement about the Tuberculosis Association in relation to the Health Council. I feel, having watched it closely, as President Farrand has put it, that here we have a very important piece of machinery for simplifying co-operative relations and developing a united front on public health.

Dr. Hatfield, will you say a few words?

Dr. Charles J. Hatfield: It is entirely too late to make a speech, ladies and gentlemen, even if I were prepared to make an extemporaneous speech on a subject of so much importance. I am very glad however to be able to state one or two things about the National Health Council.

It is very fitting indeed that Dr. Farrand should have outlined the circumstances that called for the National Health Council, because for ten years at least Dr. Farrand has worked for the coordination of the voluntary health activities, first together perhaps, and then very much more closely with the official health agencies. And it was in the office of Dr. Farrand of the Red Cross that a representative of the American Public Health Association and a representative of our Association met repeatedly for six months in 1920, to study the problem and to decide in what form it could be brought to pass.

Then as to Dr. Snow also: one of the most evident results of the National Health Council has been the combination of offices at 370 Seventh Avenue, New York City, an arrangement in which we have been very greatly interested. It was like the first practical demonstration of the principle of living together, preserving our independence but coordinating our machinery so that we might serve quite independently as production agencies, and at the same time through this combined machinery as distributing agents.

Of the Common Service Committee, I want to say very frankly that the reason it has been a success is because Dr. Snow has been there, and has been the Chairman. I know it is very pleasant to throw bouquets at your friends on the platform, but I am not throwing any bouquets; I am trying to state the exact facts. We all owe to Dr. Snow a very definite debt of gratitude for the energy and the time and the wonderful ability that he has put into this practical side of the coordination of the work of those agencies.

One thing more and I am through: we all of us are looking to a stronger and better health organization in the future than we have had in the past. We want a stronger and better National Tuberculosis Association; we also want a stronger and better organization or equipment to take care of the other parts of the field of public health that we do not occupy directly or indirectly.

As the oldest of the volunteer organizations, there is a very particular responsibility resting upon us, and that responsibility is to make free use of our experience, of our machinery, of our resources, to stimulate the development of the other health organizations that will occupy other parts of the field. When I say to make free use of all of the strength that we have, I do not mean that we should lessen the tuberculosis work by diffusion of resources: but I do mean that we should recognize the principle that, while building up the work for the prevention of tuberculosis to the utmost in the future, this work of ours is only one corner of the field; and that the whole foundation for a structure to be built later can be sound only when the other parts of the field are taken care of. Therefore, our sympathetic interest, our experience, and to a certain extent, our machinery should be devoted with a broad vision to helping other volunteer organizations.

There is one thing more we should have in mind, as volunteer agencies, and that is the point that Dr. Farrand brought out so clearly: our function is to educate and to demonstrate, the development of public opinion; and by this to complement and to support the efforts of those who are officially responsible, who bear upon their shoulders the sole legal responsibility for the health of the nation of the state and of the community.

Two things I think we must have always with us, and this National Council should point the way to them: One is a spirit of helpfulness toward any other good health interest or activity; the other is a clearness of vision as to our proper place in the field of health endeavor.

CLINICAL SECTION

Chairman

CHARLES R. AUSTRIAN, M.D.

BALTIMORE

Secretary

ELMER H. FUNK, M.D.

PHILADELPHIA

ON THE EFFECTS OF REBREATHED AIR UPON NORMAL AND TUBERCULOUS GUINEA PIGS*

By Henry Sewall, M.D. and Herbert Gutstein, M.D.

Denver

The evolution of our knowledge of the biology of ventilation has come to rest in the general belief that there is nothing specifically noxious in the properties of exhaled air. The morbid and lethal effects induced by breathing the air of crowded, confined spaces have been plausibly attributed to the mounting heat and humidity and to the excessive carbon dioxide content of the environment.

The experiments which have led to these conclusions have, for the most part, been of short duration and they appear to have altogether overlooked the possibility that rebreathed air may permanently modify metabolic reactivity in the living cells. The doctrines of immunity, which have had their birth since the fundamental pronouncements of Haldane and Smith, of Billings, Mitchell and Bergey, give to any protein moiety of the inspired air a significance not dreamed of when the main object of research was to detect an acutely poisonous protein agent in the exhalations. Indeed, it cannot be denied that one who breathes the air of congregations of necessity inhales more or less foreign protein in epidermal scales or other material irrespective of the pulmonary effluvia. The well known analogy of horse asthma establishes the potency of specific adjuvants of the atmosphere for a definite class of persons. Considerations such as these led us to an inquiry of whose ramifications this is a preliminary sketch.

Granting, for the moment, that rebreathed air contains under ordinary conditions of life, nothing essentially noxious for normal beings, what would be the effect of such air when respired intermittently for long periods by beings inoculated with a mild form of tuberculosis?

Our experiments were performed upon guinea pigs inoculated through the kind offices of Dr. H. J. Corper. The tubercle bacilli were of the human strain; subcutaneous injections of one millionth milligram in one cubic centimeter water were given in the left groin. All animals used were males and weighed about 250 to 300 grm. each. Six guinea pigs, besides controls, were under observation in as many bell jars having a capacity of ten litres each. The jars were connected by glass and rubber tubing having an internal bore of about one third inch. The air entered each jar near the bottom and left it at the top through specially bored

*From the Research Department of the National Jewish Hospital for Consumptives, Denver. Lantern Slides were shown in connection with this paper.

holes fitted with perforated rubber stoppers. The jars had an internal diameter of nearly ten inches and height of about eight inches. Each jar was supported by a wooden base two inches thick, in which was turned a gutter, an inch or more in depth, into which the rim of the jar easily fitted. This gutter was filled with mercury whose surface, except in the preliminary experiments, was kept covered with albolene. The jars thus formed a sealed system into which air entered at jar I through a rubber tube ending in a vertically suspended glass terminal containing a pith ball whose motion or position gave momentary indications of the velocity of the ventilating current. The air leaving jar VI bubbled through a small wash bottle and a water manometer connected with this by a Y tube indicated the aspirating force exerted by the filter pump which actuated the air movement. The volume of air aspirated through the jars varied from about one litre per minute at the lowest rate employed to nearly four litres at the highest. The efficiency of ventilation was measured, however, wholly by determination of the CO_2 content of the various jars. The air for analysis was drawn from any jar through a large hypodermic needle plunged into its efferent rubber tube and connected with the burette of a modified Haldane apparatus. At the rate of air flow usually employed the manometer registered in jar VI a negative pressure of 8 to 14 cm. water. When each jar contained a medium-sized guinea pig the CO_2 per cent. in jar VI after 24 hours was usually 1.5 per cent. and in jar III 0.3 per cent. Our apparatus was not competent to detect less than 0.1 per cent. CO_2 and, under the conditions described, gave no indication of CO_2 in jar I.

A thermometer, inserted through its upper rubber stopper, was constantly in place in each of the terminal jars. Our work was done in a narrow room having at one end a window and under it a steam radiator. jar I, receiving the fresh air, was near the radiator and maintained nearly constantly a temperature higher by several degrees than jar VI, the last of the series. Not infrequently, the temperature of jar I was found in the morning to be 30° C. (85° F.) its usual temperature varied between 20° and 25° C. When the temperature fell below these figures a film of moisture was likely to condense within jars V and VI.

REACTIONS OF NORMAL GUINEA PIGS CONFINED IN VENTILATED JARS

The first month of our work was devoted to study of normal, uninoculated guinea pigs confined in the jars. The results developed an unexpected complexity and demanded much more searching enquiry than we have yet been able to give to the subject. The abnormality of the confined environment was suggested in a certain stolidity of demeanor of the animals; a tendency to sit quietly with the hair ruffled. Probably the principal exciting cause of this, as well as of more exaggerated symptoms, lay in the relatively high per cent. of CO_2 in the breathed air. Observers of experience declare that guinea pigs are never seen to sleep, but they cannot have worked under the conditions we describe. Indeed, somnolence was the most characteristic symptom which our animals exhibited under certain conditions of ventilation. It reached all grades

from simple drowsiness with ruffled hair and squatting posture to a nodding relaxation humorously like the hard fought sleepiness of a person overcome in a warm and crowded lecture hall. The pig thus affected would sit flat, breathe more or less deeply, incline more and more laterally, and often suddenly drop over flat upon its side as inert, but for breathing, as a dead animal. In our experience recovery from this posture occurred within a few seconds or minutes due to disturbance by some noise or movement in the room. While asleep the animal's eyes were nearly closed and the globes turned downward. It was obvious that this hypnotic effect was purely due to the CO_2 content of the air. In a few experiments a guinea pig was confined in a closed jar supplied by aspiration with abundant pure air, to which at will a stream of washed CO_2 could be added in any desired proportion. One out of two animals thus tested was, with a certain admixture of CO_2, completely overcome, as if by general anesthetic. The proportion of CO_2 producing the hypnotic effect ranged from 0.3 per cent. to 3 per cent. There was no evidence that any other factor played an essential part. The condition was never observed when the concentration of CO_2 increased sufficiently to produce obvious respiratory reaction, nor could it be explained as a result of elevated temperature or humidity. The phenomenon of somnolence was frequently observed in the first three jars of our series, rarely if ever in the last three jars in which the concentration of respiratory products was greater. Indeed, it seemed as if something in the expired air antagonized the soporific effect of the carbon dioxide, for in jar VI whose CO_2 content was commonly 1.5 per cent. and the hypothetical organic pollution was greatest the guinea pig did not sleep, while in jar I, when, by slow ventilation the CO_2 content worked up toward 3 per cent., somnolence was frequently witnessed. No special study was made of this curious phenomenon, but its advent apparently depended largely on the momentary physiological condition of the guinea pig and had relation to its previous exposures. It should be added, moreover, that this acute somnolence was confined to experimental conditions in which the ventilating current was so reduced for one or two hours that the CO_2 content of jar VI was raised to upwards of 5 per cent.

With the six guinea pigs in place in their jars and supplied with a ventilating current which restrained the accumulation of CO_2 in jar VI to less than 2 per cent., the whole series of animals behaved in an essentially normal manner. When the ventilating current was slowed the CO_2 content mounted on an ascending scale from jar I to jar VI and, as was to have been expected, there was a roughly proportionate development of dyspneic symptoms in the series of animals.

In our preliminary experiments, when the animals were repeatedly subjected on different days to a ventilating current inadequate to their respiratory needs it was not uncommon to find one or another dead in its jar or in its cage, from a few hours to several days after removal from the jar. The autopsies on guinea pigs succumbing as described shows sometimes intense uniform congestion of the lungs; rather more frequently the lungs were pink with areas of hemorrhagic appearance and, on one occasion, nearly a whole lung was solid as in lobar pneumonia.

These fatalities were not confined to jar VI but resulted also among the occupants of all other jars. As the high mortality rate ceased after the mercury seals in which the jars stood were kept covered with albolene, there is some suspicion that volatilization of the metal had led to mercurial poisoning.

Certain irregularity in the behavior of the guinea pigs after repeated exposures in the jars led to the suspicion that the conditions of our experiments involved potent factors other than the influence of CO_2. These symptoms suggested the reactions of sensitized animals reexposed to an antigen. Accordingly we took up a line of observation designed to lead to conclusions as to whether normal guinea pigs can be sensitized to the exhalations of their own species.

EVIDENCE FOR THE SENSITIZATION OF GUINEA PIGS TO REBREATHED AIR

Many preliminary experiments were performed whose results could only be interpreted on the ground that a normal guinea pig made more or less intensely dyspneic by breathing air exhaled by companion animals acquires an allergy of its respiratory apparatus which leads to accentuation of respiratory and other symptoms when the guinea pig is re-exposed to like conditions after a lapse of twenty to forty days. We have found none but quantitative differences between the behavior of normal and suspected allergic animals, for with a sufficient concentration of CO_2 the two groups are indistinguishable. Nevertheless, when a guinea pig is re-exposed, as indicated, in the same jar with a normal animal of the same weight, there is usually observed, as the ventilating current is slowed, a well marked difference in the onset and character of reactive symptoms. Nose rubbing and scratching of the skin and intense flushing of the ears are apt to mark the behavior of the re-exposed animal. But of particular significance is a modification of respiratory movement. Periodic respiration is a common early symptom as the air deteriorates. The respiration usually becomes deeper and quicker, interspersed with deep breaths or gasps, with a jerky, forceful movement of the flank and more or less manifestation of dyspneic distress in the allergic animal while the normal control seems relatively comfortable, though breathing deeply. The latter exhibits a smooth and gradual increase in the depth and urgency of its respiration as the content of CO_2 in the air mounts, while the former is prone to enter abruptly upon the stage of obvious dyspnea. One of the most constant differences between what we have called the allergic, or re-exposed, guinea pigs and their normal controls, was in the relative persistence of dyspneic symptoms in the former after both were taken from the jar having a high CO_2 content and in which they had finally presented equal signs of disturbance. The control animal would quickly, within about a minute, recover his normal rate and character of respiration while the "allergic" animal showed exaggerated respiratory movements for several minutes.

The mode we finally adopted in carrying out these observations was as follows: Two or three normal male guinea pigs of 250 to 300 grams

were confined in jar VI. The remaining jars, I to V, each contained an adult guinea pig whose exhalations were breathed by the experimental animals in jar VI. After notation of all reactions under a full air current and the CO_2 content of jar VI had been determined, the ventilation was reduced, the per cent. of CO_2 in jar VI was determined anew about every twenty minutes and the behavior of the animals was recorded from minute to minute. Such observations would be carried on for about two hours, by which time the proportion of CO_2 in jar VI might have reached ten per cent. or more and the animals, of course, were manifesting somewhat intense distress. This "sensitizing" exposure of the guinea pigs in jar VI was usually repeated once or twice on successive days. It is worth noting that though such exposures usually appeared to be innocuous, on a few occasions the treated young guinea pigs died in their cages within one to three days afterward. Autopsy revealed more or less congestion of the lungs with scattered small hemorrhagic areas, which might sink in water when excised.

After the lapse, usually, of three weeks or more, a test reexposure was made of the pigs that had been sensitized in jar VI. In this test one or two of the animals would be confined in jar VI together with a normal subject of equal weight. Each guinea pig was isolated from its companions by a wire barrier, a matter of radical importance to prevent the creatures clumping in a way to obscure their symptoms. The reexposure was conducted essentially like the first but with even more care in recording of details. It was obvious that the main symptomatology of our animals depended simply on the excess of CO_2 in the air they breathed. Accordingly, in a number of experiments care was taken to absorb the excess of this gas in jar VI. To this end the air from the first five jars was aspirated through a large Wolff bottle the bottom of which was covered with a layer of soda lime, before entering jar VI. The air flowed into VI over a pan filled with soda lime inserted beneath the platform on which the guinea pigs rested, and from the center of the platform rose a double cylinder of wire gauze containing the same chemical. The arrangement was designed to absorb the CO_2 while leaving unaffected such organic matter as might reside in the ventilating current. The device was sufficiently effective to hold the proportion of CO_2 in jar VI at about one per cent. while in the neighboring jar V it might measure six or eight per cent. In such a case the animals in jar VI would be at ease, breathing normally, while the denizen of V would be in the throes of urgent dyspnea.

Our experiments establish the fact that all the data pointing to the production of allergy in guinea pigs receiving their preliminary exposure to rebreathed air having an excessive content of CO_2 were repeated in other animals whose sensitizing exposure was carried out in air similarly foul as regards any organic constituents, but with a far lower proportionate content of CO_2. We concluded that the evidences of sensitization obtained in our test reexposures did not depend in any way upon the physiological perturbation or the CO_2 which caused it involved in the

preliminary exposure. The obvious conclusion was that the exhalations of the guinea pig contain organic matter which, in sufficient concentration, is capable of inducing allergy in the respiratory apparatus of a normal guinea pig. When a guinea pig receives its first treatment by rebreathed air freed, as far as possible, from CO_2, it might be expected that signs of anaphylaxis would supervene on the second, test, exposure under the same conditions, that is, with low CO_2 content. This does not appear to be the case. In such animals, as in those previously described, the evidences of sensitization could only be elicited with certainty in rebreathed air containing a fair proportion, one to three per cent., of CO_2. Our conclusion was that the material in animal exhalations which induces allergy operates upon the respiratory mechanism in a way to cause a lowering of the threshold of irritability to the action of CO_2.

THE EFFECT OF CONFINEMENT IN REBREATHED AIR UPON TUBERCULOUS GUINEA PIGS

Some thirty male guinea pigs, weighing approximately 250 to 300 grams each, were inoculated by Dr. Corper in two groups, November 28 and December 6, 1921. Approximately 2 mgm. of a culture of tubercle bacilli, human strain, were weighed and with utmost care were ground into a homogeneous emulsion with a few drops of salt solution. Through successive dilutions a water clear suspension was obtained in which it was calculated each cubic centimeter contained 0.000,001 milligram tubercle bacilli. Each guinea pig was injected with 1 cc. subcutaneously in the left groin. On January 10, after the lapse of thirty-five or forty-three days, all animals presented well marked local lesions of tuberculosis. It was planned to confine six of the infected animals, each in its allotted jar, for continuous periods until the necessity of receiving food or cleansing the jars arose. In practise it was found convenient to limit the periods of confinement to from twelve to thirty-six hours.

From December 2 to April 25 the jars were occupied by these animals somewhat more than half the time. When one of the experimental animals died it was replaced by one of the controls, that showing the best physical condition being chosen. Daily estimations of the CO_2 in jars VI and III were made during the conduct of the experiment and careful records were taken of the demeanor and respiration of each guinea pig. The usual per cent. of CO_2 in jar VI was 1.5 per cent. rarely it rose to 2 per cent. In jar III it was usually 0.3, rarely 0.5 per cent. Only one fatality occurred among the controls, sixty-seven days after inoculation. Extensive tuberculous infection of spleen and liver was found but no macroscopic tubercles appeared in the lungs. This guinea pig should not have been included in our series, since note was made at the outset of its relatively poor physical condition. At the time of its death all the other controls were in flourishing state. The animals relegated to the jars began to show rather early signs of morbid reactivity. The symptoms manifested were stolidity of demeanor, flat posture, sometimes marked somno-

lence and, finally, marked respiratory embarrassment leading to rapid panting. Many times it seemed obvious that life was saved by removing the animals to their cage. When taken from the jars, they at once, unless far advanced in the disease, assumed the lively behavior of normal guinea pigs. Up to April 25, 140 days after the last inoculation, all the control pigs, with the exception noted, were alive and mostly in fair condition.

Following is the record of fatalities among guinea pigs confined in the jars:

Jar V. First death occurred December 10, eight days after beginning confinement and four days after infection. There was reaction at site of inoculation; there was slight splenic enlargement and peri-splenic exudate. Cause of death uncertain, but the result was paralleled by similar experiences with normal animals. The second death in jar V occurred thirty-one days after beginning jar treatment and thirty-five days after inoculation. Autopsy showed marked tuberculous involvement of abdominal nodes and liver; the spleen was greatly enlarged but without macroscopic tubercles. The lungs were collapsed and red mottled, but contained no evidence of tubercle.

Jar. VI. First death occurred one hundred and sixteen days after beginning jar treatment and one hundred and twelve days after inoculation. The autopsy findings were most remarkable. There was moderate enlargement of abdominal lymph nodes; the liver was large and but two or three white nodules appeared on the surface; the spleen was much enlarged but contained no visible tubercles. On opening the chest the lungs did not collapse but were practically solid with tuberculous deposits. The tracheo-bronchial nodes were the size of beans.

Jar. I. First death occurred one hundred and thirty-nine days after entering the jar and one hundred and thirty-five days after inoculation. There was profound tuberculous involvement of liver and spleen and enlargement of suprarenals and abdominal nodes. The lungs collapsed fairly on opening chest and contained posteriorly several yellowish areas of tuberculous deposit about one cm. in diameter.

SUMMARY AND CONCLUSIONS

Under the conditions of our investigation, it is clear that an evil influence of some sort affects guinea pigs confined in glass jars, though supplied with what would seem to be an ample ventilating current. Though the pathological effects distinctly increase with decrease in ventilation there was not found evidence of a regular increasing noxiousness in the air of the ascending series of jars. As the outcome of many experiments we have found sufficient evidence to postulate respiratory sensitization in animals breathing in exhaled air. We have no facts touching the nature or orgin of the protein matter thus signalized in the rebreathed air. It must be admitted that the data on which this important conclusion is founded depend on the interpretation of symptoms concerning which

there might often have been a difference of opinion. But no such criticism could be brought against the results obtained with the tuberculous guinea pigs. To them life in the closed jars was strikingly favorable to the advance of their disease. No better evidence of the modifying effect of environment could be easily demonstrated. The great contrast between the post mortem findings in the animals dying in jars I and VI seems highly significant. In the first case the guinea pig was subjected for nearly 140 days to an average high, often rather excessively high, temperature. In the second case the animal for 116 days was exposed intermittently to rebreathed air foul enough to give rise to an average CO_2 content of 1.5 per cent. In the occupant of jar I the abdominal organs showed intense involvement with tuberculosis, while the lungs were *relatively* slightly affected. In the occupant of jar VI there was very slight macroscopic evidence of abdominal tuberculosis while the lungs were nearly solid with tuberculous deposits.

Further and more detailed evidence on all these points will be presented elsewhere.

PNEUMOCONIOSIS AND TUBERCULOSIS

By H. R. M. Landis, M.D.

Philadelphia

Since the time of Ramazzini it has been recognized that dust has been capable of producing changes in the respiratory system. Furthermore, the opinion has prevailed for many years that occupations which exposed the worker to the inhalation of dust were attended by an unduly high incidence of pulmonary tuberculosis. In spite of the fact that certain forms of dust produce as definite and as characteristic changes in the lungs as do bacteria, the disease pneumoconiosis rarely, if ever, figures as such in our morbidity or mortality returns. It is practically always disguised under some other term, as for example, chronic bronchitis, asthma, pleurisy, tuberculosis, etc. There can be no doubt but that in a considerable percentage of cases a diagnosis of pulmonary tuberculosis is made when in reality the condition is a pure pneumoconiosis. This is to be ascribed to the fact that the symptoms and physical signs are frequently identical and too much is taken for granted. Repeated sputum examinations are essential and I know of no other way of definitely determining whether in a given case it is one of uncomplicated pneumoconiosis or there is a super imposed tuberculous infection.

The literature on the subject of pneumoconiosis is enormous but, it must be confessed, much of it is worthless. In the first place, until very recently, there was no distinction made as to the effects of different types of dust. The usual classification of dusts was that of organic, inorganic, and mixed, and all were looked upon as being equally harmful. Fortunately within the past few years the effects of these different types have been more thoroughly studied.

It is now quite generally accepted that organic dusts, such as vegetable or animal fibres, produce no changes in the lungs. Certainly up to date, pathological proof is wanting. Inorganic dust, on the other hand, does produce characteristic changes, the evolution of which are as definite as any produced by micro-organisms. There is ample proof of this. Mixed dusts which consist of both organic and inorganic material are dangerous in proportion to the amount of inorganic matter, the organic content being of little consequence.

It is with inorganic dust, therefore, that we are chiefly concerned. While any of the inorganic dusts are capable of causing mischief in the lungs, repeated studies have shown that these dusts vary tremendously in the effects they produce. Thus the power to cause damage ranges from pure silica, the most dangerous of all forms of dust, to the relatively

innocuous cement dust. Silica, for example, may bring about a complete crippling of the worker in so brief a period as from two to eight years, if the exposure is sufficiently intense. Coal dust, on the other hand, even with marked exposure, usually takes twenty to thirty years to produce changes sufficient to produce symptoms. Collis has emphasized this variability of the effects of dust not only as to the production of fibrosis but also as to the incidence of an associated tuberculosis. It seems quite clear that a high percentage of cases of silicosis develop tuberculosis; certain other dusts, on the other hand, do not seem to increase the susceptibility, and some, indeed, are said to act as a preventive of tuberculosis.

Much of our information regarding the incidence of tuberculosis in various industries is open to criticism. For the most part the data relating to the frequency of tuberculosis in a given industry is obtained in one of two ways. First, the number of deaths occurring in a certain industry is taken as an index as to the harmfulness of their particular employment. As a result of this many occupations have received a bad name when as a matter of fact there was nothing in the industry itself to warrant such a deduction. Second, most of the surveys that have been made have followed the plan of making medical examinations of groups of workers, tabulating the defects found and then assuming that if there was a high percentage of certain abnormalities, these abnormalities were to be charged against the occupation. For example, several years ago an extensive survey was made of one of the textile trades. Among the defects found with great frequency was pyorrhea. It was concluded, therefore, that this trade predisposed the workers to pyorrhea; an assumption that certainly had little to warrant it.

An additional factor that is too often lost sight of is the influence of the trade process. A man in stating his occupation will almost invariably give the general designation, as for example, hatter, potter, etc. In most occupations there is a great diversity of processes. Some of these processes involve no risk of any kind, in others there may be a distinct industrial hazard. Thus a man may state that he is employed in a pottery and as a result is usually classed as a potter. Closer questioning as to the particular work he does in the pottery may reveal the fact that he is a decorator or a packer, in neither of which is there any hazard; or he may be a dipper in which case the risk is that of lead poisoning and not the inhalation of dust; in all other trade processes connected with the manufacture of pottery or sanitary ware, dust constitutes a distinct hazard.

Still another factor that is often neglected is a knowledge of exposure to tuberculosis in the home. In any considerable group of workers, no matter what the occupation may be, it will be found that there is evidence of existing cases of tuberculosis in their immediate families. In such cases it would be difficult to state whether the worker became infected because of his occupation or because of exposure to the disease in his home.

Finally it is urged that any study of the influence of occupation on the causation of disease should include a knowledge of the conditions under which the workers live.

This brief outline of some of the factors involved in determining the relationship existing between pneumoconiosis and tuberculosis may be illustrated by an analysis of a group of potters whom I have had under observation. For some years past the Potters' Union has sent many of its members to the White Haven Sanatorium, located in White Haven, Pa. Up to date there have been 88 cases, all being sent to the Sanatorium under the belief that they had tuberculosis.

Length of Employment

6 mo.	1-5	5-10	10-15	15-20	20-25	25-30	30-35	35-40	45-50
1	5	8	11	9	7	10	11	13	8

It is known that the type of dust occurring in potteries is not especially irritant and that it takes at least ten years to show any changes. Of this group 6 had been employed five years or less and 8 for ten years or under. It is hardly probable that any of them had received sufficient pulmonary damage to increase their susceptibility to tuberculosis. Certainly in the case of a man who worked as a potter no longer than one or two years and then showed signs of tuberculosis, the industry could hardly be charged with it.

It should also be noted that 32 of the group had followed the occupation from 30 to 50 years before they manifested any symptoms.

Trade Process

Presser	61
Jiggerman	9
Kilnman	9
Saggermaker	1
Decorator	2
Dipper	3
Packer	1

Pressers, jiggermen, kilnmen. and saggermakers are all exposed to dust under about the same conditions. Decorators have to do with the ornamentation of china ware and are not exposed to dust in the slightest. In the case of dippers the hazard is that of lead poising; dust is a very minor factor. The one listed as a packer worked in the store room and packed the finished china for shipping.

It will be seen, therefore, that 6 of the group designating their trade as that of potter were not exposed to the dust at all and had no opportunity of developing pneumoconiosis. Tuberculosis, therefore, is not to be charged to dust in these cases.

Exposure to Tuberculosis

Exposure in the family	22
Exposure elsewhere	6

In this group of 88 patients 22 stated that some member or members of the immediate family (father, mother, brother or sister) had died of the disease. In six more there had been exposure through a tuberculous wife or intimate associate.

In those cases in which it was known that infection existed in the family it would be difficult to fix the source of the infection. To charge it against the industry would be manifestly unfair. To a less extent this is true where the exposure is less intense but still a possible source of the trouble.

Tubercle Bacilli in the Sputum.

Tubercle bacilli present	72
Tubercle bacilli absent	16

Although all of these 88 patients were sent to the Sanatorium as cases of tuberculosis it was impossible to establish such a diagnosis in 16 or 22.2 per cent. The sputum was repeatedly examined in these cases but tubercle bacilli could never be demonstrated.

It is to be borne in mind that, in the early stages of pneumoconiosis, without an associated tuberculous lesion, the physical signs are practically negative. In the third stage the physical signs are marked and nearly always are not to be distinguished from those found in advanced tuberculosis. Furthermore, it is not always possible even with the x-rays to determine whether the case is one of pneumoconiosis alone or whether there is an associated tuberculous lesion. The examination of the sputum then is our chief reliance in detecting those who have and those who have not tuberculosis. Neglect of this precaution has led to the inclusion in tuberculosis statistics of a fairly high percentage of cases in which extensive fibrosis of the lungs, the result of a pneumoconiosis, is the actual trouble.

TYPE OF TUBERCULOSIS OCCURRING IN POTTERS

Finally, a word as to the type of tuberculosis which as a rule is encountered in this occupation.

When tuberculosis is superimposed on the pneumoconiosis in most instances it is non-toxic. The constitutional symptoms, such as fever, tachycardia, sweating, etc., are slight and in most instances quickly disappear with rest.

The lack of toxic symptoms is to be ascribed, I believe, to the extensive fibrosis present. This tends to limit the spread of the disease and also to prevent absorption.

It is well known that in cases of tuberculosis in which fibroid tissue forms very slightly or not at all the disease spreads rapidly and toxic

symptoms are marked. On the other hand, in chronic cases with marked fibrotic changes the disease is of long duration and toxic symptoms are absent or very slight.

The presence of a marked fibrosis in these cases would seem to argue in favor of its rendering the lungs less susceptible to the tubercle bacillus, rather than increasing the susceptibility. This, indeed, is said to be true of coal dust. This dust is not especially irritating and the fibrosis it gives rise to is very slow in its evolution.

In the case of potters it seems to be true that the tuberculosis is not apt to develop until after many years in the trade and that when it does it is frequently of a latent type.

On the other hand, the evidence that silicosis is, in the great majority of instances, associated with tuberculosis, sooner or later, is undoubtedly true.

The reason is not clear. I would advance the following hypothesis: Silica is the most irritant of all dusts and those exposed to it in its pure form are incapacitated in from two to eight years. In other words it will produce as much damage in this brief period as occurs after thirty to fifty years in a pottery or in a coal mine. Instead of being a slow chronic process, silicosis is subacute and in some instances distinctly an acute process. It would seem therefore, that lungs acutely or subacutely inflamed might readily become a fertile field for the tubercle bacillus.

In conclusion it is to be borne in mind that no dust, not even silica, can cause tuberculosis. It may as in the case of silica, predispose the individual to the disease, but without the presence of the tubercle bacillus tuberculosis can not develop.

DISCUSSION ON PAPER BY DR. LANDIS

Dr. Edward O. Otis, Boston: This subject of pneumoconiosis from silicious dust is one of much importance both from the point of view of differential diagnosis and of prophylaxis. The Section may recall the paper of Dr. Jarvis of Barre, Vermont, upon this subject presented at the annual meeting of the Association last year, For several years Dr. Jarvis has been carrying on a series of investigations with granite cutters at Barre and his x-ray plates are very illuminating, showing the various and varying lung conditions resulting from the long continued inhalation of granite dust. Neither from the x-ray evidence nor from the symptoms and physical signs can one differentiate between a pure case of pneumoconiosis and a case of fibroid tuberculosis. The former, pneumoconiosis, may exist alone and finally produce fatal results or tuberculosis may supervene and be the determining factor in the result. When the latter occurs it may be considered, which I think is Dr. Jarvis' conclusion, an incident in the course of the pathological changes produced by the inhalation of the silicious dust, grafted upon a destructive process already going on in the lungs. Tubercle bacilli may or may not be discovered in the sputum even when

tuberculosis exists. When the sputum is positive, as Dr. Jarvis says, "it does not seem to alter the clinical course or enable one to elicit added physical signs." In a recent case reported by Dr. Cabot of the Massachusetts General Hospital an old stone cutter showing extensive infiltration and disorganization of one lung, after a series of hemorrhages, finally died of one. Before death the diagnosis was made of either pneumoconiosis or tuberculosis. On autopsy, however, no evidence of tuberculosis was found, although there was extensive destructive disease with a cavity. Another very interesting point brought out by Dr. Jarvis is the disappearance of extensive x-ray mottling after the granite cutter has discontinued his occupation, provided he has not worked at it too long. Again, Dr. Jarvis has found that there is a difference racially in the way the stone cutter suffers from his occupations: the Italian, for example, "gets by" the most easily in the stone cutting industry while the Irish do badly.

Dr. Kennon Dunham, Cincinnati: This report of Dr. Landis is particularly interesting because he has been studying this subject for many years. I rise principally to ask him to go further into the explanation of his statement that we have no evidence of pathology from organic dust. It would seem to us from our studies that we have several cases from the hair factories which give definite evidence of unusual density in the lungs. The changes shown in the plates of these hair factory cases consist of large areas of increased density in the lung which suggest unresolved pneumonia rather than the fibrosis of which Dr. Landis spoke.

The other point that I would like to make a plea for is the x-ray diagnosis in these cases with special reference to density, since in making physical examinations of chests you are studying sound and touch only. Everybody will acknowledge the value of history in the interpretation of physical findings, and very seldom do we expect the x-ray man to take into consideration the history of the physical. The patient in almost all of those cases can be helped very materially if you bring the history and symptoms of the patient, and let the x-ray man determine his diagnosis in that light as well as in the abstract light of density.

Dr. E. A. Gray, Chicago: Something over forty years ago I read, for the first time, a reference to pneumoconiosis by Hardy, who stated in his novel, "Put Yourself in His Place," that the knife-grinder of Sheffield never lived to see his grandchildren—that he died of knife-grinder's consumption at thirty. I wish to make the point, however, that it is not altogether dry grinding which causes pneumoconiosis.

It was my privilege, some years ago, to make a study of grinding machines in the plants of the International Harvester Company in Chicago. One type of machine was the four-foot, open stone wheel which was constantly doused with a copious stream of water. The other type of machine was also a wet grinder, but was inclosed. Both wheels were used in the production of sickel knives. The point in the study was to

determine what became of the wheel in the course of the grinding. In three or four weeks the four foot wheel would be ground down to a diameter of two feet. Supposedly, the water had washed the detritus into the sewer, but it was discovered that much of it, in the form of mud, had been splashed onto the faces of the workers. The mud was a mixture of impalpably ground steel and stone and was found on all parts of the workmen's faces, in their noses and even in their mouths. This grinding could not be considered in any sense, dry; it was wet, the stone was wet, the men were wet, and yet, the average life of a man at the wheel was less than 12 years. The closed-in type of machine was wet, but the worker was so protected that he was at all times dry.

It was found that after a man had worked at a job such as this, for eight or nine years, it was advisable, in justice to himself, to change him to something else. Such a man, however, cannot work as fast on another job, and is usually unwilling to change. He works until he breaks down, and when he does break down he never comes back; nor is there any chance of his condition becoming better. His lungs are positively filled with grit from stone and steel. If any of you have seen emery bags, such as our grandmothers used to brighten their needles, and if you ever, in an idle moment, ran your pocket knife through one, you know the feel of the section knife as it cuts through such a grit-laden lung at autopsy. These cases terminate slowly; when there is no demonstrable tuberculosis, the man slows down, he walks slowly, acts deliberately. He never hurries, he cannot, he has not enough lung tissue to finance any activity, so to speak.

At autopsy, in several cases, we have found that the functioning lung tissue was limited to a strip about an inch thick. These men had not inhaled their dust, they had eaten it in the form of mud; they had not taken time to wash before their midday meals. This increased the hazard.

It would be well for those who live in rural districts to remember that farmers may also be pneumoconiotics, their wives, too, sometimes. The farmer slows down, after his years of hard work, his lungs filled with dust, about the time the city dweller begins to think about enjoying life. The physical diagnosis of this disease is interesting and definite—not quite so difficult as Dr. Landis intimates. We have the barrel-shaped chest, general limitation of motion, no expansion, perhaps, and marked diminution of breath sounds. This diminution, or absence of respiratory murmur, is quite important—what one does not hear in the chest is often as important, or more so than what one does hear. I have found that when tuberculosis appears, it is nearly always a one-sided lesion; the signs are fairly distinct and often definite.

Students in our medical colleges should be taught more of pneumoconiosis than the name.

Dr. H. R. M. Landis: Replying to Dr. Dunham about organic dust, all I can say is that in all of the industries which Dr. Pancoast and

I studied, the offender in all cases proved to be mixed dust; in other words, the real difficulty was inorganic material that was mixed with the organic material.

I remember two years ago that a study was made of a large jute factory in Holyoke, Massachusetts by Dr. Drinker of the Harvard Medical School. It was believed that the dust from the jute produced frequent respiratory symptoms among the workers. In making the analysis of the dust, it was found that about 60 per cent. of this dust was really inorganic material. In a carpet factory, which was the dustiest place I have ever been in, the x-ray plates showed no more change than ordinary. This dust was almost entirely organic; there was relatively little inorganic material in it--it was producing apparently no ill effects.

As to the use of the x-ray, I would say that in the first stages of pneumoconiosis, the x-ray picture is only suggestive; the physical examination is absolutely negative. In the second stage, the physical examination is almost invariably negative, but the x-ray picture is definite and perfectly clear. The only way you can recognize the condition in the early stages is by the use of the x-ray. Of course, in the third stage, it is recognized quite easily by both methods, the only problem to solve is whether there is a superimposed tuberculous infection.

I am glad that the diaphram has also been mentioned, as in almost every case there is marked limitation of this muscle, and practically in all cases of advanced pneumoconiosis, the diaphragm is either very materially limited, or almost entirely fixed. You can determine this condition by reason of these individuals being amazingly short of breath. The diaphragm, if it becomes fixed, either partially or completely, makes breathing an extremely difficult proposition. It is only during the last few years that people have been paying any attention to this most important organ of the whole respiratory mechanism. It has largely escaped notice in most discussions on the subject.

AN ANALYSIS OF PULMONARY SUPPURATIVE CONDITIONS WITH REFERENCE TO THE INDICATIONS FOR TREATMENT BY PNEUMOTHORAX, PARTIAL AND COMPLETE*

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(Abstract)

The application of the principle of selective collapse to the treatment of ordinary pulmonary tuberculosis by artificial pneumothorax has been described in the American Review of Tuberculosis for April, 1922. In that article we laid the greatest stress upon the care which must be exercised in the selection of cases, and also upon the careful attention which must be given to each case during the entire course of treatment. After further experience with the treatment we are inclined to emphasize still further the constant attention and study which cases under this treatment require. No one should attempt to give partial (or for that matter any kind of) pneumothorax treatment who is not already skilled in the treatment of tuberculosis, nor should the treatment of these cases be entrusted to assistants of only a few months training. We have found that the number of cases which our preliminary report states can be cared for by one operator is too high. Thirty cases require more care and attention than it is possible for one operator to keep up continuously. We therefore wish to modify this statement to the effect that no operator should attempt to care for more than fifteen of these cases simultaneously.

The indications and contra-indications for the use of this method in the usual types of pulmonary tuberculosis have already been given. Briefly stated, the method is particularly suitable for all those cases of pulmonary tuberculosis which would seem not beyond hope of recovery, but yet which need some help beyond that afforded by the ordinary treatment to start them on the road to health; and also to cases of acutely progressive but not too far advanced lesions which do not promptly respond to treatment. An adequate x-ray service is indispensible, and the technique must be one which will show the pleural surfaces. The complete pathology of every case selected should be thoroughly studied and understood in all of its details before the treatment is attempted. If, after a careful study, it does not appear that the extent and distribu-

* Approved for Publication by the Surgeon General.

tion of the disease is such that the aid afforded by the partial collapse will be sufficient to turn the balance of forces toward recovery, the treatment should not be attempted.

The principle of selective collapse applies equally to lesions of the upper and lower lobes. We will show you plates which demonstrate that in lower lobe lesions the greater part of the air of a partial pneumothorax will remain localized over the lesion, just as it does in lesions of the upper lobe. But the pathological lesions of the lower lobe, including as they do the pulmonary suppurations, and being more extensive, deep seated, and irregular, are much more difficult to diagnose in detail than are those of the upper lobe. The purpose of this paper is to differentiate between the pulmonary suppurative processes which are suitable for complete pneumothorax, those sultable for partial pneumothorax, and those which are not suitable for pneumothorax treatment of any kind.

The suppurative conditions of the lower lobe cannot usually be distinguished from each other by physical signs or clinical symptoms. The same case will show widely different signs and symptoms at different times, and very dissimiliar conditions may show physical signs and symptoms which are so much alike that they might easily be mistaken for cases of almost identical pathology. The chief aids in diagnosis are a carefully taken history of the case and stereoscopic x-ray plates of suitable technique, but no means of examination should be neglected, as any one undertaking the treatment of a pulmonary suppuration needs every scrap of information which he can obtain. A discussion of some of the differential diagnostic points which are not usually given in text books is included in our larger paper. In this abstract we can only mention a few common misconceptions. In the first place, the expectoration of a large amount of foul sputum which separates into three layers indicates nothing more than that there is some reservoir in the thorax in which the sputum collects and undergoes putrufactive changes, as in abscess, gangrene, putrid bronchitis, bronchiectasis, tuberculous cavity, or empyema. Secondly, the continuous and persistent absence of tubercle bacilli from such a sputum not only does not prove the case to be non-tuberculous, but is not even presumptive evidence that the putrifying focus was not in its early stages directly due to tuberculosis itself. Thirdly, the various pulmonary suppurations are more likely to occur upon tuberculous soil than in a healthy person, the other etiological factors being the same. When occurring in a tuberculous patient they are more likely to become mild and chronic in their course and they usually develop more slowly.

The differentiation of the various pulmonary suppurations and the discussion of the reasons for or against various methods of treatment in these conditions is given in our larger paper. Briefly stated the conclusions are as follows:

A. PULMONARY SUPPURATIONS IN PATIENTS WITH NO COMPLICATING TUBERCULOSIS

1. *Bronchiectasis (essential).* Pneumothorax of any kind is contra-indicated.

2. *Bronchiectasis secondary to contracture of tissues.* Pneumothorax of any kind contra-indicated.

3. *Conditions which are non-progressive and involve both the bronchi and the adjacent parenchyma.*

a. *Bronchiectatic abscess.*

b. *Chronic simple abscess.*

c. *Purulent bronchitis with dilatation, putrid bronchitis and peribronchitis, etc.* Treatment by any kind of pneumothorax is contra-indicated in all of these.

4. *Abscess proper.*

a. *Foreign body abscesses.* Bronchoscopic treatment indicated. Partial pneumothorax may be used as adjuvant to the bronchoscopic treatment. In any abscess of undetermined etiology, bronchoscopic examination should not be neglected.

b. *Abscesses extending into lung from extra-pulmonary suppurative conditions.* Pneumothorax treatment is in general not suitable.

c. *Abscess dependent upon special diseases such as actinomycosis, amebiasis, malignant disease, infected cysts, etc.* Treatment should be that of the special disease, and pneumothorax treatment is not suitable.

d. *Post-influenzal abscess.* Pneumothorax treatment is almost always impossible. If possible, is usually contra-indicated by the nearness to the pleura and danger of rupture.

e. *Post-pneumonic abscess.* The suppurative pneumonitis which accompanies abscess always simulates ordinary pneumonia at some stage. We have seldom seen a lung abscess which was not diagnosed as pneumonia at some time during its course. We have never seen a pulmonary abscess due to lobar pneumonia with no other etiological factor. But we do not doubt that it can occur.

f. *Aspiration abscess.* Among these are included the abscesses which follow tonsillectomy and other operations on the respiratory and oral passages. The indication is preeminently for a more or less complete pneumothorax at a very early date. At a later date pneumothorax is likely to be impossible on account of adhesions. If there is actual necrosis or cavity near the pleura, pneumothorax should only be performed in consultation with a surgeon who is prepared to operate if indicated. See discussion of post-hemorrhagic aspiration abscess in the summary.

g. *Infarct type of abscess.* Pneumothorax of any kind is usually impossible on account of adhesions, and is contra-indicated except as a preliminary to surgical treatment.

B. SUPPURATIVE CONDITIONS DUE TO OR ASSOCIATED WITH TUBERCULOSIS

1. *Aspiration abscess in tuberculosis cases.* Partial pneumothorax is indicated and should be performed as soon as the diagnosis is established.

2. *Abscess following tuberculous extention.* Partial pneumothorax is indicated and should be performed early.

3. *Abscess with empyema draining through a bronchus.* Pneumothorax of any kind contra-indicated.

4. *Multiple abscess in tuberculous cases.* Partial pneumothorax, often bilateral, is indicated if adhesions do not prevent it.

5. *Secondary bronchiectasis and purulent bronchitis in tuberculous cases.* Pneumothorax of any kind is usually impossible and even if possible cannot be expected to repay the time and work spent. If there are foci elsewhere in the lungs, the indications for partial pneumothorax are as in any tuberculous case.

SUMMARY

Pneumothorax of any kind is contra-indicated in bronchiectasis, chronic localized suppurations lined with epithelium and surrounded by unyielding walls, empyema discharging through an abscess or fistula, abscess near the pleura (except as a preliminary to surgical intervention), and all suppurative lesions of the lung which are secondary to diseases in other parts.

More or less complete pneumothorax is by far the best and safest treatment for aspiration abscesses, provided it can be used before adhesions form and while the abscess is still central. A fairly large partial pneumothorax may be used as an adjuvant to other treatment in certain other forms of abscess; in foreign body abscess to the bronchoscopic treatment; in abscesses of surgical size as a preliminary to operative measures.

Partial pneumothorax is the best treatment for all small abscesses associated with tuberculosis, excepting those connected with empyemata, and excepting extensive bronchiectatic processes enclosed in firm and unyielding fibrosis. It is often valuable as an adjuvant to other forms of treatment in special cases of other types of abscess.

It is evident from the above outline that the most brilliant results from the use of strictly partial collapse in pulmonary suppurative processes, are obtained in those cases in which there is either manifest tuberculosis or a tuberculous element in the etiology. The percentage of such cases is much higher than is ordinarily supposed, as it is usually impossible to find tubercle bacilli in the sputum. Post haemorrhagic abscesses are usually upon a tuberculous soil. At the time of rupture, any abscess may produce haemorrhage, but if the foul and purulent sputum was subsequent to a haemorrhage which occurred a few weeks or months previously,

tuberculosis should be sought for. In all unexplained and atypical pulmonary suppurations, a tuberculous element should be suspected, and every effort made to determine all of the casual factors, as the hope of cure in these cases depends upon accurate and minute diagnosis, not only of the principle conditions, but of all etiological and pathological details.

REFERENCE

Thompson, J. C. and Barlow, N.: Roentgen-ray technique for the demonstration of small pneumothorax. Amer. Jour. Roent., April, 1922.

DISCUSSION ON PAPER BY DR. BARLOW

Dr. Herbert M. Rich, Detroit: Last year I offered a paper on this topic which was declined on the ground that it was not dealing with tuberculosis. I am glad that Dr. Barlow was successful in getting this before the men who have to do this work. Lung abscesses as commonly met are a very serious disease. The mortality in the general hospitals from all forms of lung abscesses is something like 85 per cent., and anything we can do to remove mortality of that sort is certainly very desirable.

It has been shown in a certain number of cases that pneumothorax is exceedingly efficient treatment for early cases of lung abscesses, and the men who are in this section are the men who will have to do the work, and will have to teach the general surgeon and the general practitioner the importance of early recognition and early treatment in these cases.

Now a lung abscess in the upper lobe not infrequently drains itself and heals spontaneously. We have all seen those cases. A lung abscess in the lower lobe, I believe, never heals, never drains itself completely and never heals spontaneously. So far as I know, that is correct.

It becomes necessary then, for that abscess in the lower lobe to be treated, and if it is near the hilus, surgery is a very great risk. If the abscesses are in the periphery, surgery is the proper treatment, so it happens that our offering of pneumothorax does not supplant surgery, but supplements it because those cases which form the greatest risk for the surgeon are the most favorable cases for treatment by pneumothorax.

Member: Dr. Tewksbury of Washington has a series of 25 cases and I have had the pleasure of treating 15 cases, making a series of 40 cases, and the mortality of those 40 cases is 20 per cent. and not 85 per cent. Eighty per cent. of those people are living and well. The cure is very interesting, and in very many cases, three days from the time of he first treatment, the patient passed from being very seriously ill to a period of apparent quiet and rest, and in many cases, two injections were enough to complete the cure.

Dr. Barlow: In answer to Dr. Otis, I would say that Major Kramer and myself, in this study which we are reporting, have treated no cases of bronchiectasis—I mean true bronchiectasis and nothing else—but individu-

ally we have had the experience with such cases that the patients were at most only temporarily improved; they were not any better after the treatment was discontinued than they were before we started. We find in searching through the literature that the greater number of people who have written on bronchiectasis, and whose articles show that they discriminated between bronchiectasis and the conditions which simulate it, agree with us in that conclusion.

I can not tell you why this is a fact, because I do not know. It may be that, as the pathologists tell us, the bronchi atrophy, lose their elasticity and are very much stretched and dilated, so that they can not become permanently contracted, even under pneumothorax. As these cavities are lined with epithelium, they can not be expected to heal in a collapsed state as do abscesses. The walls of the thorax are usually barrel-shaped and dilated, so that as soon as the pneumothorax is discontinued, the lung is again put upon a stretch. I don't know whether these are the reasons or not.

In regard to the abscesses which the doctor who followed told us did not get well, they were evidently old ones; they waited too long before beginning treatment by pneumothorax. The purpose of this paper is to show that some, but not all types of abscess are suitable to treatment by artificial pneumothorax. If they were all aspiration abscesses, it is possible that they would all have done well if they had been treated in the first place by a pneumothorax, which should have been more or less complete.

Dr. Rich gave an excellent summary of the general problem, and our views are in close accord with those which he expressed.

A STUDY OF THE CASES DISCHARGED FROM THE EAGLEVILLE SANATORIUM FOR CONSUMPTIVES, 1910 - 1921

By A. J. Cohen, M.D.

Philadelphia

The following study was primarily undertaken for our own information, to see what was happening to the cases discharged from the Eagleville Sanatorium; but as the accumulated data were studied and compiled, they were considered sufficiently interesting to record, and to add to the statistics already available on this subject.

The figures cover a period of eleven years, beginning July 1910 and ending June 1921. The sanatorium was opened in September 1909, and was designed to care for curable cases. It was a purely local institution, drawing its clientele from Philadelphia only, and all beds were free. There was at that time no social service department, and no attempt was made to do social service work until five years later. From 1914 to 1919, the social service work done was meagre in quanity and poor in quality; it was done through another agency and we had no control over the workers, and not enough money to improve the service. In the fall of 1919, through an arrangement with the University of Pennsylvania, the Eagleville Sanatorium took over the Hospital Department of the Henry Phipps Institute, started a tuberculosis dispensary at the Institute and organized a social service department of its own under the able management of Miss Amy L. Seyfert, and it was through her valuable assistance that this piece of work was made possible.

For the purpose of this study, only those cases discharged under the designation, "disease arrested" or "improved" were selected. It was obvious that nothing could be looked for among the cases that were discharged "unimproved."

The total number of cases selected was 936. Of these 500 had been discharged "disease arrested," and 436, "improved." A questionnaire was prepared asking five questions. The questions were designed in the simplest form because the people receiving them were mainly foreigners and not of the most co-operative type; and it was hoped that by not burdening their mentality, or trying their patience, the responses would be more numerous. The following were the questions: (1.) What has been the condition of your health since you left the Sanatorium? (2.) What have been the occupations you engaged in since? (3.) What

is your present occupation? (4.) What are your present earnings? (5.) Are you now in need of any assistance?

The 936 questionnaires mailed brought 206 responses. An investigator who had had a large experience in handling our type of case was then employed to locate the cases not heard from. She made 1500 visits covering a period of four months and located 347 additional cases. The list of names was then sent to the Social Service Exchange, which is a central registry for all welfare agencies in Philadelphia; their files were searched and registration on 143 additional cases was returned. The various agencies which registered these 143 cases were then communicated with, and the latest address was visited. In this way, 36 additional cases were located. The entire list of names was then subjected to a search in the mortality records of the Bureau of Vital Statistics of Philadelphia, where 32 deaths were uncovered, in addition to the 92 deaths that had been previously reported.

A compilation of the figures on the information obtained is as follows:

Of the 936 cases discharged "disease arrested" and "improved," in the last eleven years:

Living in Philadelphia	442	47.24 per cent.
Reported Dead	124	13.24 per cent.
Left the City	55	5.87 per cent.
Unlocated	315	33.65 per cent.
	936	100.00 per cent.
Total number cases located	621	66.35 per cent.

Of the 315 unlocated cases, I am quite sure, though I can only base my opinion on negative results, that the vast majority of them are living and are doing well; first, because they are not to be found in the mortality records, and secondly, because they are not registered with any welfare agency. The majority of those who completely recover from tuberculosis, and especially if they become properous, have a tendency to deny they ever had the disease, and few want to acknowledge that they ever were recipients of charity once they become economically independent. The following case demonstrates that fact.

I was called in to see a child of an ex-Eagleville patient last winter, and I had a physician with me. I asked my friend to wait in the sitting room while I went up to the bed room to see the child. The father of the child had been one of the first patients at Eagleville, and had, since his discharge, nine years ago, become very prosperous. As he took me to the door, I introduced him to the doctor, and very proudly said to the doctor, "This is one of our ex-Eagleville cases." And with that this man put his finger up to his mouth and said in a whispered tone, "Not so loud, my wife does not know I ever had tuberculosis." This man had been married seven or eight years.

Nor is it likely that many of these migrated. All of our cases are from Philadelphia, and of the working class. Most of them depend in whole or in part upon some relief-giving agency for support during their protracted illness and these agencies prevent, as far as possible, the migration of dependents from one community to another. So that I think I am within the bounds of reason when I say that the majority of the unlocated cases are living and doing well.

Of the 55 who left the city, we have no record and no effort was made to locate them.

Of the 936 cases, 500 had been discharged "disease arrested," and 436 "improved."

TABLE I

Table Showing Present Status Of 500 Cases Discharged "Disease Arrested"

Classification	Number Discharged	Number Located	Per cent. Located	Results in cases Located	Per cent.
Men	159	121	81.1	73—Satisfactory Cond. 8—Unsatisfactory " 28—Dead 12—Left the City	60.3 6.6 23.1 10.0
Women	161	115	71.4	80—Satisfactory Cond. 3—Unsatisfactory " 18—Dead 14—Left the City	69.6 2.6 15.7 12.1
Children	180	147	81.7	134—Satisfactory Cond. 6—Unsatisfactory " 0—Dead 7—Left the City	91.2 4.0 — 4.8
Summary					
Men Women Children	500	383	76.6	287—Satisfactory Cond. 17—Unsatisfactory " 46—Dead 33—Left the City	74.9 4.4 12.1 8.6

NOTE: Of the 147 children located, 27 boys had grown to manhood and 35 girls to womanhood, making 62 in all. 56 are in satisfactory condition or 90.3%, and 6, or 9.7%, are in unsatisfactory condition.

Here it should be explained that the cases discharged "disease arrested," must be free from subjective symptoms; physical signs must indicate quiesence of the lesion; sputum must be free from tubercle bacilli for five successive examinations at intervals of two weeks; the weight must be up to normal or over, using the Nylic Standard Table

of Heights and Weights; and the patient must be at work eight hours a day for four successive weeks without any elevation of temperature or other abnormal objective or subjective phenomena.

If a patient should leave with or without the consent of his chief, without fulfilling the above conditions, he is listed "improved."

The located cases were classified as "satisfactory" when they were self-supporting as men, or looking after their households as women, or attending school in the usual way as children. Men were classified "unsatisfactory" when dependent in whole or in part, as a result of ill health, either on some welfare agency or their relatives; women were classified unsatisfactory if they were unable to attend to their household duties.

Of the 500 cases discharged "disease arrested," there were:

159 men	31.8 per cent.
161 women	32.2 per cent.
180 children	36.0 per cent.

Of these 500, there were located:

121 men	81.1 per cent.
115 women	71.4 per cent.
147 children	81.7 per cent.

Of the 121 men located:

73, or 60.3 per cent. were in satisfactory condition
8, or 6.6 per cent. were in unsatisfactory condition
28, or 23.1 per cent. were reported dead
12, or 10.0 per cent. left the city

Of the 115 women located:

80, or 69.6 per cent. were in satisfactory condition
3, or 2.6 per cent. were in unsatisfactory condition
18, or 15.7 per cent. were reported dead
14, or 12.1 per cent. left the city

Of the 147 children located:

134, or 91.2 per cent. were in satisfactory condition
6, or 4.0 per cent. were in unsatisfactory condition
0. .....were reported dead
7, or 4.8 per cent. left the city

Of the 147 children, 27 boys had grown to manhood, and 35 girls to womanhood. Of these 62, 56 were in satisfactory condition and 6 were in unsatisfactory condition. These 62 cases are included in the statistics above on children.

A study of the condition on admission of the disease arrested group cases shows that, according to the Turban scheme,

33.3 per cent. were admitted as Stage 1
49.3 per cent. were admitted as Stage 2
17.4 per cent. were admitted as Stage 3

Tubercle bacilli in the sputum were found in eight per cent. of these cases upon admission.

The average length of stay in the Sanatorium for this group, was 195 days.

Table 1 gives an analysis of the "Disease arrested" group.

There were discharged "Improved" 436 cases.

Cases listed under the heading, "improved" present the greatest variety of conditions. It includes, on the one hand, those who stayed a few weeks, and left because they did not like it, or because they were dismissed for insubordination; and, on the other hand, those who had been in the Sanatorium a year or more, doing well, on five or six hours exercise, and who left within a few weeks of complete recovery.

Of these 436 cases, there were:

183 men.....	41.9 per cent.
195 women.....	44.7 per cent.
58 children.....	13.4 per cent.

Of these 436, there were located:

108 men.....	59.0 per cent.
109 women.....	55.9 per cent.
21 children.....	36.2 per cent.

Of the 108 men located:

46, or 42.6 per cent. were in satisfactory condition
5, or 4.6 per cent. were in unsatisfactory condition
42, or 38.9 per cent. were reported dead
15, or 13.9 per cent. left the city

Of the 109 women located:

54, or 49.5 per cent. were in satisfactory condition
12, or 11.0 per cent. were in unsatisfactory condition
36, or 33.5 per cent. were reported dead
7, or 6.0 per cent. left the city

Of the 21 children located: 21, or 100 per cent. were in satisfactory condition.

The condition on admission for this group was as follows:

19.0 per cent. were admitted as Stage 1
64.8 per cent. were admitted as Stage 2
16.2 per cent. were admitted as Stage 3

Tubercle bacilli in the sputum were found in 42 per cent. of these cases on admission.

The average length of stay in the Sanatorium for this group was 227 days.

I am quite certain that most of the surviving "improved" cases, especially those in satisfactory condition, belong to a group who leave the Sanatorium a short time before being discharged by the chief as "disease arrested." Some balk at the exercise, some are influenced by domestic conditions; others because of financial pressure—so while they really are in good condition, they cannot be designated "disease arrested" because they have failed to fulfill the prescribed requirements which would entitle them to be so designated. This, I believe, gives the improved group a better showing than is actually the case.

Table 2 gives an analysis of the "improved" group, and table 3 an analysis of the two groups combined.

TABLE 2

Table Showing Present Status Of 436 Cases Discharged "Improved"

Classification	Number Discharged	Number Located	Per cent. Located	Results in cases Located	Per cent.
Men	183	108	59.0	46—Satisfactory Cond. 5—Unsatisfactory " 42—Dead 15—Left the City	42.6 4.6 38.9 13.9
Women	195	109	55.9	54—Satisfactory Cond. 12—Unsatisfactory " 36—Dead 7—Left the City	49.5 11.0 33.5 6.0
Children	58	21	36.2	21—Satisfactory Cond. 0—Unsatisfactory " 0—Dead 0—Left the City	100.0
Summary					
Men Women Children	436	238	54.6	121—Satisfactory Cond. 17—Unsatisfactory " 78—Dead 22—Left the City	50.9 7.1 32.8 9.2

A comparative study of Tables 1 and 2 indicates that more men were located than women—that a higher percentage of women remained in satisfactory condition of health than men; and that the death rate among the women was somewhat lower than among the men in each group.

Tables 4 and 5 which will be referred to as the longevity tables, were designed to show the length of time that these cases survived after

leaving the Sanatorium. They show the number of discharges in each group for each year, and the number of survivors year by year, to date.

It will also be seen by these charts, that the surviving cases were divided into three groups, designated A, B, and C—A representing the cases discharged between 1910 and 1912, inclusive; B, between 1913 and 1916 inclusive, and C, between 1917 and 1920. It is interesting to note that, in the disease arrested group:

10 per cent. have survived 10 years
32 per cent. have survived 6½ years
58 per cent. have survived 3 years

while in the improved group:

4.5 per cent. have survived 10 years
20.4 per cent. have survived 6½ years
75.0 per cent. have survived 3 years

indicating that the life period in the improved group is about one-half of that in the disease arrested group. And it further shows that the chances of survival and the chances of remaining in a satisfactory condition are three to one in favor of the disease arrested group, over those discharged improved.

TABLE 3

Table Showing Present Status Of 936 Cases Discharged "Disease Arrested" and "Improved"

Classification	Number Discharged	Number Located	Per cent. Located	Results in cases Located	Per cent.
Men	342	229	66.9	119—Satisfactory Cond. 13—Unsatisfactory " 70—Dead 27—Left the City	52.0 5.6 30.6 11.8
Women	356	224	63.1	134—Satisfactory Cond. 15—Unsatisfactory " 54—Dead 21—Left the City	59.8 6.7 24.1 9.4
Children	238	168	70.6	155—Satisfactory Cond. 6—Unsatisfactory " 0—Dead 7—Left the City	92.3 3.6 0.0 4.1
Summary					
Men Women Children	936	621	66.3	408—Satisfactory Cond. 34—Unsatisfactory " 124—Dead 55—Left the City	65.7 5.3 20.0 9.0

TABLE 4

Table Showing Longevity Of Cases Discharged "Disease Arrested"

159 men disch. "D. A."
121 men located
81 reported living
73 in Satisfactory Condition

Year Disch.	No. Disch.	No. Living	Per-cent	Years Living
1920	23	17	74	1
1919	22	18	82	2
1918	14	4	29	3
1917	11	6	56	4
1916	15	5	34	5
1915	24	10	42	6
1914	12	6	50	7
1913	14	5	36	8
1912	8	4	50	9
1911	12	6	50	10
1910	4	0	—	11
Totals	159	81	51	

	Years Living	No. Men	Per-cent
Group A 1910-12	10	10	12.2
Group B 1913-16	6½	26	32.3
Group C 1917-20	2½	45	55.5
		81	100.0

161 women disch. "D. A."
115 women located
83 reported living
80 in Satisfactory Condition

Year Disch.	No. Disch.	No. Living	Per-cent	Years Living
1920	16	11	68	1
1919	27	21	78	2
1916	14	9	65	3
1915	16	10	63	4
1917	16	11	69	5
1918	20	9	45	6
1914	12	2	17	7
1913	17	6	35	8
1912	15	0	—	9
1911	7	3	43	10
1910	1	1	100	11
	161	83	52	

	Years Living	No. Women	Per-cent
Group A 1910-12	10	4	4.8
Group B 1913-16	6½	28	33.7
Group C 1917-20	2½	51	61.5
		83	100.0

*** 180 children disch. "D. A."
147 children located
140 reported living
134 in Satisfactory Condition

Year Disch.	No. Disch.	No. Living	Per-cent	Years Living
1920	32	26	81	1
1919	18	14	78	2
1918	16	11	69	3
1917	19	15	79	4
1916	20	15	75	5
1915	20	18	90	6
1914	14	11	79	7
1913	21	18	86	8
1912	20	12	60	9
1911	—	—	—	—
1910	—	—	—	—
	180	140	78	

	Years Living	No. Children	Per-cent
Group A 1912–14	8	41	29.3
Group B 1915–17	5	48	34.3
Group C 1918-20	2	51	3.64
		140	100.0

*** Children's Dept. not opened until 1912

TABLE 5

Table Showing Longevity Of Cases Discharged "Improved"

Men

183 men disch. "Imp."
108 men located
51 men living
46 in Satisfactory Condition

Year Disch.	No. Disch.	No. Living	Per-cent	Years Living
1920	25	18	72	1
1919	27	7	24	2
1918	27	13	48	3
1917	17	3	17	4
1916	28	1	35	5
1915	15	5	33	6
1914	20	2	10	7
1913	10	2	20	8
1912	8	0	—	9
1911	2	0	—	10
1910	4	0	—	11
Totals	183	51	28	

	Years Living	No. Men	Per-cent
Group A 1910-12	10	0	——
Group B 1913-16	6½	10	19.6
Group C 1917-20	2½	41	80.4
		51	

Women

195 women disch. "Imp."
109 women located
66 reported living
54 Satisfactory Condition

Year Disch.	No. Disch.	No. Living	Per-cent	Years Living
1920	18	14	77	1
1919	19	13	68	2
1918	25	14	56	3
1917	30	5	16	4
1916	19	7	37	5
1915	17	1	6	6
1914	22	5	22	7
1913	14	1	7	8
1912	24	5	21	9
1911	2	0	—	10
1910	5	1	20	11
	195	66	33	

	Years Living	No. Women	Per-cent
Group A	10	6	9
Group B 1913-16	6½	14	21.2
Group C 1917-20	2½	46	69.8
		66	

*** *Children*

58 children disch. "Imp."
21 children located
21 children reported living
21 in Satisfactory Condition

Year Disch.	No. Disch.	No. Living	Per-cent	Years Living
1920	6	3	50	1
1919	8	4	50	2
1918	5	1	20	3
1917	11	3	27	4
1916	5	0	—	5
1915	9	5	55	6
1914	5	3	60	7
1913	5	1	20	8
1912	4	1	25	9
1911	—	—	—	—
1910	—	—	—	—
	58	21	36	

	Years Living	No. Children	Per-cent
Group A 1912-14	8	8	38
Group B 1915-17	5	8	38
Group C 1918-20	2	5	24
		21	

*** Children's Dept. not opened until 1912.

The children, of course, do best. One hundred and fifty-five out of 168, or 92.2 per cent, discharged over a period of nine years, are in a satisfactory condition, 62 of whom have grown to maturity. It is doubtful if all these children had pulmonary tuberculosis as we know it in the adult; but most of them came from tuberculous stock; all of them were underweight; a large proportion of them coughed and had more or less fever; and about 10 per cent. of them had demonstrable lesions in the lungs. Therefore, if not actually tuberculous in the strict anatomical sense, they were unquestionably potential stock for the future development of tuberculosis.

Among the 124 deaths recorded, 33 were not due to tuberculosis. Some of the causes of death were apoplexy; acute articular rheumatism; accidental death; uremia, etc., and 50 deaths, or 40 per cent. of all the recorded deaths, occurred during the years 1918 and 1919, a large proportion of which were undoubtedly due to, or initiated by an attack of influenza during the pandemic.

An effort was made to determine the earning power of the cases located. Ninety-three men showed an average earning per week of $25, the earnings ranging from $12 to $100 a week. The average earnings of these men prior to admission and before the onset of their illness, was $15 a week. The earning power of the women working also increased after their discharge, though not to the same extent as that of the men. The average earning per week for the women before admission was $13.50 and $15 after discharge. It might be said that the generally higher wage-rate prevailing at the time the survey was made is responsible for the apparent increase in earnings, but it is to be borne in mind that a good many admissions were made during the war-time wage rate, and these are included in the figures representing the earnings prior to admission, in which case one offsets the other, so that the figures given may be considered as fairly representing the situation. It might also be said that a number, especially the most prosperous ones, did not disclose their true earnings. I have in mind a half dozen, among whom were a couple of boot-leggers and real estate operators, who I know made more than $100 a week.

Thirty different occupations are engaged in by the 197 men of whom a record is available. Among the number may be mentioned, printers, bookbinders, painters, paper-hangers, ship-fitters, carpenters, roofers, farmers, laundrymen, shirt-makers, bakers, tailors, merchants, physicians, dentists, druggists, one lawyer, the banquet manager of one of our largest hotels and a professional base-ball player.

Among the women who are not housewives, we find twenty occupations given, such as factory workers, salesgirls, stenographers, bookkeepers, school teachers, nurses, an actress, a midwife and a technician.

SUMMARY

The interesting facts brought out by this survey seem to be the following:

Without any previous attempt to follow up the discharged cases, 621 out of 936, or 66.3 per cent. were definitely located. Four hundred and eight, or 65.7 per cent. of these were found to be leading normal lives, and economically independent, and we have reasonable ground for believing that most of the unlocated cases are living and doing well.

The earnings of the average case increased after discharge, and the occupations engaged in were as many and varied as before admission.

Children do infinitely better than adults, and while a greater proportion of women remain in what is called a "satisfactory" condition, they do not survive as long as the men.

The death rate is three times greater among the improved than among the disease arrested cases.

A very small percentage of the improved cases survive the seventh year.

If I may be permitted to draw any conclusions from the data here given, I should merely reiterate what has so often been said—that early diagnosis and prompt and persistent sanatorium care offers the best chance for the successful treatment of this disease, and to this I would add that the suspected and tainted children should receive our special and diligent attention.

DISCUSSION ON PAPER BY DR. COHEN

Dr. B. S. Antonowsky, Liberty, N. Y.: It would seem they are getting at Eagleville Sanatorium end results, not obtainable elsewhere. If my memory serves me right, a report by Dr. Taylor of Halifax, England states that of 1,914 cases, five years after discharge, 76.5 per cent. were dead and of the remaining 23.5 per cent. that were living, only half were able to work.

The London County Insurance Committee reports upon 1,484 tuberculous patients, giving 47 per cent. unable and unfit to work at the time of discharge.

Trudeau Sanatorium, reporting upon patients traced twenty years after their discharge, finds that 80 per cent. of them are dead and that in 92 per cent. of those that died tuberculosis was given as the cause of death.

REMARKS ON THE FEDERAL CARE OF TUBERCULOUS EX-SOLDIERS

By Stephen A. Douglass, M.D.
National Home D. V. S., Ohio

From a sentimental, as well as from a practical point of view, no subject comes nearer to our people than the care of the disabled ex-soldiers. The problem has been a difficult one because of the vast number of men involved and also because of the desire to do even more than was possible to alleviate the illnesses and disabilities affecting these men. However, not only in this country but also in practically all the European countries, the plans originally adopted have met with far from unanimous approval. On the one hand the Government has been criticised for reckless extravagance and inefficiency and the soldiers for unreasonable and unwarranted demands; on the other hand, it has been claimed that the service was slow and inadequate and that men were suffering undue hardships and delay.

I realize that a frank discussion of this subject, which in these days is taking up so much newspaper space with more or less exaggerated statements, charges, counter-charges, and investigations by various organizations demands considerable temerity on my part. It is, however, very essential that certain fundamental facts be known and appreciated before intelligent and unbiased opinion can be formed, particularly by the public which is footing the bill. Government failure here, Government failure there, has been so consistently propagated that only recently has it been brought to light what tremendous work this Government has accomplished in hospitalization and rehabilitation.

First of all, let us realize the fact that this Government is doing more and spending more on this work than practically all the Allied nations combined, who suffered four long years of warfare, and whose losses were far greater than ours.

I am holding no brief for the Government but the *Baltimore Sun's* recent "Callous Indifference" editorial would hardly appear to hold water in view of the following facts. Let me here enumerate some of the activities of the Veterans' Bureau.

Since 1918, including the appropriation for this year, $1,410,000,000 has been expended for the relief of ex-service men and their families. One million dollars is being paid every day including Sunday directly into the hands of the ex-service man or his dependents. Thirty thousand men are being provided hospital care without cost to them, this care representing an expenditure by the Government of $60,000,000 per an-

num. Vocational training is being given to 100,000 men at an expenditure for tuition and training allowance of $30,000,000 per annum; 50,000 medical examinations are being made monthly; 20,000 men are receiving medical treatment every month at clinics outside of hospitals; 1,000 claims are being handled daily in addition to the 1,500,000 on file. More than $300,000,000 has already been paid in compensation and $510,000,000 has been appropriated to the Veterans' Bureau for 1922 expenditures. In addition, the American Red Cross spent $10,000,000 for soldier relief alone during 1921. Today there are being hospitalized under Government control, in Government hospitals, 22,440 World War Veterans. This does not include patients in contract hospitals, who now number more than 9,000. There are under construction 7,592 beds which will be ready for occupancy within the next few months, and the Government is at present contemplating at least 2,500 more beds under the new Langley bill. So within a very short time the Government will have, under its direct administration, hospital capacity for a minimum of 32,000 patients, which is estimated to be the "peak of the load," and which is recognized as the greatest hospitalization program ever undertaken by any country.

It is true that considerable time elapsed before adequate facilities could be provided. The delay was unfortunate and was caused because no plan had been prepared in advance to meet the situation which involved enormous machinery including hospitals, sanatoria, dispensaries, and medical service for returned soldiers on their voluntary application for such care.

The examination of soldiers for discharge from the army and the first report as to percentage and type of disability was the function of the medical departments. Following discharge the soldier passed from a single control, the Army or Navy Department, to a status in which he had to look to three different Government Departments for action. Two of these, the Bureau of War Risk Insurance and the U. S. Public Health Service, were related purely as a paper relationship since both were under the direction of the Secretary of the Treasury. The third, the Federal Board for Vocational Education, was responsible only to Congress. It had no relation to, nor co-ordination with, the two other services directly charged with the care of the Veterans. Recognizing the manifest faults of such a system and the almost universal criticism directed against it, it became necessary to create the machinery necessary to insure greater co-ordination and more direct responsibility. Under this plan a single department was formed which is held responsible for the care of the veteran—the United States Veterans' Bureau. The various agencies heretofore engaged, as well as every other possible source of assistance in economic and physical reconstruction of the disabled, has been called upon to aid in the work.

Fourteen regional or district offices have been established throughout the country and working from these fourteen districts offices are 140 sub-offices. The fourteen district offices, under rules and regulations pre-

scribed, hear complaints, examine, rate and award compensation claims, grant medical, surgical, dental and hospital treatment, convalescent care and grant vocational training.

Today this Government under the broad interpretation of its "Compensation Act" finds its tuberculosis problem its paramount problem whose solution will take at least fifteen years, and it is asserted by those who give the subject serious consideration that the "peak of the load" will not be reached for several years.

The influence of warfare on the incidence of tuberculosis is, of course, considerable. We should not, however, lose sight of that group of young men, unfortunately passed by the selective draft, although definitely tuberculous who after being inducted, diagnosed, labeled tuberculous and discharged, have ever since, so to speak been "on the Government," utilizing valuable bed space which should have been used by those who really "broke" in the service.

This is cited to bring to light a phase of the Government's great inheritance of tuberculosis. I recently asked the statistician of a large life insurance company if he believed the incidence of tuberculosis greater among ex-service men than among the general population of the same age; he stated, "No, statistics do not show it, we simply know where they are, as four million men have had careful physical examination and have been diagnosed and have the opportunity to secure hospital treatment."

With the wholesale discharge of tuberculous cases from the military service, it devolved mainly upon the United States Public Health Service, the Army and the National Homes for Disabled Volunteer Soldiers to assume the gigantic task of hospitalization and treatment. At this time there are in all probability enough beds in Government owned hospitals to accomodate every *bone fide* tuberculous case needing treatment. I say this in view of the fact that many Government Hospitals are constantly carrying a 25 per cent. "overload" of men who do not need hospitalization. This statement is further substantiated by Elliot's figures based on Canadian experience of 3,000 beds per million troops.

Enormous strides have been made, particularly by the U. S. Public Health Service, to extend its service and facilities. At this time there are more than thirty institutions of this service caring for 10,000 tuberculosis cases.

The National Military Home service has, at this time in seven institutions, more than 1,500 beds for tuberculosis and by July 1 will have approximately 2,500 beds available in its various branches. One institution of this service, The National Sanatorium at Johnson City, Tenn. has 1,000 beds for tuberculosis patients.

Many difficulties had to be overcome in the National Military Home service. Almost overnight this service which was a "Home" service, had been transformed from a purely custodial service with old traditions, customs and methods of operation, to a hospital service caring for an entirely different class of patients and demanding modern methods of administration. The Military Home custodial idea is forced into insigni-

ficance because of the growth and demand for a modern hospital service which overshadows all other activities.

A metamorphosis is taking place and remarkable strides have been made to meet the situation. A complete reorganization was necessary in many of the institutions, several of which are devoting all their activities along special lines, i. e., the Johnson City, Tennessee, Branch, tuberculosis, the Marion, Indiana, Branch, neuro-psychiatrics. One very interesting phase of this service will be the complete decentralization of the tuberculosis departments at the Dayton, Milwaukee and California Branches, with a director in control of the departments including the personnel. This important phase, involving a basic principle of successful sanatorium practice, has not been inaugurated because of the many currents, if you please, that militate against such a departure from the old order of things.

To meet the early hospital emergency, the United States Public Health Service contracted with private, municipal and state tuberculosis sanatoriums for hospital accomodations. This arrangement has been and is still being criticized, perhaps rightly so, in some intances, but it was the only solution at the time and while prompt action did not allow of discrimination in institutions, the results obtained should now prove whether or not it was "good business." It is very apparent that those cases hospitalized on contract in state sanatoria with their well organized medical and nursing staffs received and are receiving as good care and treatment as could be received anywhere in this country. I believe also that this can be said of the district, municipal and many private sanatoria. The mushroom variety of private sanatorium which organized to meet the emergency and solicited contracts is open to suspicion.

One distinct advantage of the contract civil sanatorium, to the ex-service man, was in the fact that these men, who had experienced the tedium and demoralization of army life, were thrown with a group of civilian patients who were primarily interested in getting well and who of necessity must limit their days of disability by strict adherence to every detail of the "cure." I believe a great many of us who were overseas experience a period of unrest before returning to a state of "normalcy." The medical director of every civil sanatorium caring for ex-service men observed and appreciated, I am sure, the difficulty these men had in adjusting themselves to civilian sanatorium regimen. In spite of the fact that every vestige of army regulations and traditions had been removed many of these men came to the "cure" reluctantly and without enthusiasm.

To one who, for a decade at a state sanatorium, observed intimately the characteristics of civilian patients from every walk of life, the class and characteristics of the ex-service man undergoing the same regimen and for the same purpose would not at first thought seem particularly different. But there is a vast difference and it is impressive at once. The civilian patient must of necessity limit his days of disability by making it a business to get well. The ex-service man need not necessarily do

so. His philosophy, in many instances, is that he is being paid to stay in a hospital. Among a considerable group compensation is the vital object and almost the whole subject of interest and of discussion. In many instances the patient is receiving over and above his living a great deal more money than he ever had in his life. The incentive to make a fight to get well by adherence to a strict regimen, which is all important from the standpoint of recovery from tuberculosis, is gone in many cases. In other words, the very thing for which we are striving is being defeated by ourselves, mostly due to the fact that there are no strings on the monthly compensation check.

The two great problems confronting us under present conditions, as Lyman so well states, are first, "the control of the group which because of lack of intelligence or self control either refuses to get well themselves or let the other fellow do so, and second the group who establish the record of their disease in order to draw compensation, but who insist upon making their own decisions as to when they are well enough to go home with the result that both they and the country at large must in the future pay a heavy cost in suffering and in money because of their refusal to take proper care of themselves." The treatment and progress of the conscientious serious-minded majority is constantly hampered by this element. The lack of means to control this class of patients persisted until the U. S. Veterans' Bureau was forced by public opinion in September, 1921 to promulgate G. O. No. 27 and it marks one of the most disgraceful eras in the annals of modern hospital history. I am not familiar with the experience of the Public Health Service but I feel sure somehow they exercised such measures as were necessary to insure ordinary good discipline. The National Military Home Service perhaps suffered most because it became a dumping ground for a large number of "tourist patients" who had outraged and torn down the standards of other hospitals and whose doors were closed to them. This service, which admits a patient simply on the authority of an honorable discharge from the army or navy until the promulgation of G. O. No. 27-A, had no means to defend itself but was, of course, held responsible and came in for criticism that was unjust, inasmuch as the criticism emanated from those whose duty it was to see that such conditions could not possibly exist. Before this order became effective, which contemplates that when a patient becomes hospitalized, he behaves himself and stays "put" until his treatment is completed, we had developed the so-called "tourist or migratory type" of patients. It is not infrequent even now to admit a patient who states he has been in a half dozen hospitals. One man recently admitted at Dayton had been across the continent and back again making a short sojourn in a dozen hospitals, and had, I estimated, utilized more than six hundred dollars of Government transportation. This is "chasing the cure" to the nth degree.

The following is from the *Journal of the American Medical Association,* August 13, 1921.

"The Director of the Bureau of War Risk Insurance was a witness last week before the Senate Committee and testified concerning conditions at the National Sanatorium, Johnson City, Tenn., where 850 tuberculous veterans are patients. He declared that agents of the Government Bureau had conducted a secret investigation and discovered that the inmates were living under the most astounding conditions of vice, corruption and immorality. Unless Congress took immediate action, he asserted, the deaths at the Johnson City institution would be higher than occurred among the troops during the war. An investigator for the War Risk Bureau who lived in the institution for a week as a patient testified to having bought morphine, moonshine and extract of ginger containing 95 per cent. alcohol. He stated that the grounds were overrun with immoral women, the witness testified that many patients carried revolvers and that there was no discipline. Senator Walsh, a member of the committee demanded that the evidence be submitted to the Attorney General for prosecution."

During the past year, as member of the Disciplinary Board of a Military Hospital, it has been my misfortune to sit on more disciplinary cases than I handled in ten years as the superintendent of a state tuberculosis sanatorium, with approximately the same sized service. Government hospital service has had to stand for this sort of thing because it has not been able to call to its aid an informed and enlightened public opinion, which would back up its efforts towards establishing this much needed reform. The salutory effect of G. O. No. 27-A, which when enforced has the "teeth" to control the situation is becoming more evident and along with this there has been a marked improvement in regimen, in morale, and in medical results.

One very dangerous phase of the National Military Home as well as the State Home Service, to my mind, will be the tendency of the old domiciliary idea to prevail and to become applicable to these young World War men.

If the bars are down to men who have completed their hospital treatment and they are then allowed to be transferred to "Barracks" and become "members" of the Home a very pernicious influence begins. When one observes the group of robust Spanish American War veterans and regulars on the sunny side of fifty who have become entirely devoid of ambition and incentive and who go on year after year, entirely content to "live, move and have their being" within the cloisters of the Home, receiving clothing, food, lodging, tobacco, and laundry, one cannot but realize that the example and precept is anything but an incentive to many of these young impressionable men, who very soon acquire the idea that the "World," in this case the Government, "owes them a living."

War is an economic failure, so tremendous that it has only to be properly studied and visualized to be realized. Every time a veteran of American wars has to go to a Government Hospital an economic loss is sustained by the country, and the big task we are informed, in reports which have been made public, is to reduce, wherever it is practical, honorable, and possible, the hospitalization increase in the country. One man in the Federal Service some time ago declared; "We are trying to make the soldier who passed through the experiences of war understand

that his obligation to the country did not cease when he laid aside his gun; that he, along with his fellow citizens, faces a peace obligation essential and vital to his country's future." When a former soldier goes to a Governmental Hospital the nation loses his services as an economic force. America and Americans are prepared, if necessary, to spend billions for the men who fought and who need help. This is as it should be. As we understand it, the discussion which continues over hospitalization increase in the nation does not center about a desire to curtail, but merely to afford a basis for computation along an economic line. There surely can be no disposition to outweigh the principles of gratitude to these men, young or old, with a sensitiveness about the money required for adequate provision in their behalf.

DISCUSSION ON PAPER BY DR. DOUGLASS

Dr. S. Adolphus Knopf, New York: As one who has been connected with one of the U. S. Public Health Service Hospitals (No. 61 at Fox Hills, S. I.) as attending specialist, I desire to express my appreciation of the able defense of the U. S. Government made by the preceding speaker. There can be no criticism of what has been said but only endorsement.

Prior to entering upon my duties at Fox Hills, I thought that nearly thirty years' experience in tuberculosis had taught me all about the psychology of the tuberculous, but I was mistaken in this assumption. I had to learn that the effect of tuberculosis on the ex-soldier is different from its effect on one who has never been other than a civilian patient. After having been freed from the military discipline to which he had been subjected in the army, he did not like the idea of being disciplined to get well, nor could he be subjected to the discipline of a civilian who would be discharged from the institution if he disobeyed the rules. Every now and then, when the doctors sought to discipline the ex-soldier patient because of absence without leave, for imbibing too freely, or for other violation of the rules of the hospital, he would complain of harsh treatment to the ever ready newspaper reporter.

You all must have read of the malicious attacks upon the officers of Fox Hills and the personnel in general, none of which, to the best of my knowledge, had the slightest foundation. The attacks on the inadequacy and cheap construction of the buildings were particularly severe, and yet nobody could be blamed for the existing structures which were erected in ninety days to serve as a debarkation hospital for the sick and wounded returned from overseas. The U. S. Public Health Service had to take these buildings as they were and improve the structures as was possible. These buildings were never intended for tuberculous patients, nevertheless patients were made comfortable there, and in the many years of my service in public hospitals for civilians, I have never seen more care bestowed on the patients nor, I may frankly say, any better food than I have seen in the tuberculosis hospitals of the U. S. Public Health Service.

The best evidence that the ex-soldiers were satisfied, that they had been well treated at Fox Hills, came when the War Veterans' Bureau issued orders for all tuberculous patients to leave. Patients and relatives of patients all begged that the service at Fox Hills should be continued. The patients had the choice of three other hospitals and yet they preferred to stay. The reason for closing Fox Hills Hospital was because of the possible danger of fire in view of the fact that all the buildings were constructed of wood and exposed to high winds.

As a whole I may say that in spite of the fact that the mental attitude of the tuberculous ex-soldiers is somewhat different from that of the civilian, we had really very little difficulty especially when one considers that we had at times 1,200 tuberculous patients to take care of. I have had personal evidence of gratitude and satisfaction from many tuberculous invalids under our care at Fox Hills. With few exceptions all felt that the Government had done its best and continues to try to do its best for its tuberculous ex-soldiers.

Dr. Edward O. Otis, Boston: In the matter of dealing with ex-service men suffering from tuberculosis or with suspects it is my experience that the government desires and tries to deal with these men justly and generously, and whenever a suspicion of pulmonary tuberculosis arises or a diagnosis of the disease has been made by somebody the Veterans' Bureau employs every means to verify the diagnosis. The trouble is, however, as I see it, that there appears to be no body which has the power to make a final decision, accordingly, and close the case. Through various means and appeals, some of the ex-service men who seem to be disappointed because tuberculosis has not been detected, so that they can receive compensation, appear again for examination, and so the same process, as at first, has to be repeated and an additional and unnecessary expense in consequence is incurred.

Again, when tuberculosis has been diagnosed and the ex-service man is placed under treatment in a Bureau hospital or sanatorium there seems to be a lack of power to enforce proper discipline and, as we all know, the secret of obtaining results in the treatment of tuberculosis is discipline. I can imagine nothing more discouraging to the physician of hospital or sanatorium than to feel that he has not complete authority over his patient.

I believe, as I said, that the Veterans' Bureau desires and tries to deal justly and generously with the ex-service tuberculous man or with the man who suspects or is suspected of having tuberculosis. When, therefore, the Bureau has made a decision, one way or the other, that decision should be final and not subject to reopening unless for good cause. And again, when the Bureau has placed a tuberculous ex-service man under treatment its physicians should have the power to enforce proper treatment and the power can only be obtained by withholding compensation when discipline is broken.

THE PROBLEM OF THE TUBERCULOSIS SUSPECT*

By John B. Hawes, 2nd., M.D.

Boston

I have chosen this subject of the "tuberculosis suspect" because I believe that it represents a weak point in our endeavors to diagnose tuberculosis in its early stages.

Patients suspected of having tuberculosis may be divided roughly into three classes, only one of which I shall consider here.

The first group comprises many ex-service men who are called "Tb. suspects." Although they constitute a difficult and trying problem, it is not one which often directly concerns the general practitioner but is almost entirely in the hands of the Veterans' Bureau or the Public Health Service.

The second group consists of those patients whom we all are constantly meeting in our private practice. This group is a large one or a small one according to the diligence and skill of the physician and the impression he is able to make upon his patient as to the seriousness of his case. This group likewise I shall not consider here.

The third group to which I would call your attention consists of those patients, men, women and children, who attend our out-patient departments and dispensaries and in whom a provisional diagnosis of tuberculosis is made. It is a comparatively small and fortunate few who are given a definite diagnosis on the first visit. I have always maintained that the man who came in to an out-patient department and whose sputum was at once found to be positive to tuberculosis or who had a large hemorrhage while at the clinic might well be considered fortunate, simply because in his case the diagnosis was at once established and adequate treatment instituted. There are many, however—the great majority indeed—in whom the diagnosis is not so clear and who are, therefore, asked to return for x-ray examination and with temperature and pulse records, sputum, etc. In such instances, the diagnosis usually put down on the patient's record is "Ph?". These patients are always asked to return for further examination but in far too many instances they do not return. The solution of this problem is not an easy one. The present situation as it exists in my own city is not satisfactory and I believe that the same situation exists elsewhere.

Early in the year, 1921, when I became president of the Boston Tuberculosis Association, the first problem that I asked my executive committee

* Read by title.

to undertake was in regard to this point. I had often asked myself what became of the men, women and children in whom I, for instance, at my clinic at the Massachusetts General Hospital, had made a provisional diagnosis of pulmonary tuberculosis and had asked to come back in a week for further study but who never came back. What happened to them? Did they go to other dispensaries or to private doctors or did they drift along until they reached the advanced stages of this disease? In far too many instances, the latter, I fear, was the true answer. At all events, I persuaded my executive committee to allow Miss B. W. Billings, the executive secretary of our Association, and myself to conduct a survey of the city with this point in view. A careful and detailed study was made of all patients in whom there had been a definite diagnosis or a provisional diagnosis of pulmonary tuberculosis at the six large out-patient departments and dispensaries of the city of Boston. The present condition of every one of these patients who came to these out-patient departments from April, 1920, to April, 1921, was investigated.

The following was found to be the situation concerning the tuberculosis suspect. Out of a total of 963 patients included in this study there were 415 in whom a provisional diagnosis of pulmonary tuberculosis had been made. From their histories it was evident that the great majority of these had been advised to return for further examination, but that in comparatively few instances had this advice been followed up by home visits, with the result that none of these 415 patients returned for a definite and final diagnosis to the out-patient department in which the provisional diagnosis had been made. There were 140 who afterwards visited some other institution or private physician and were re-examined, 92 or 69 per cent. of whom were definitely diagnosed as having pulmonary tuberculosis and so reported. Even deducting this group, however, there remains a large number, 338 or 45 per cent., of the original 963 patients, who were strongly suspected of having tuberculosis, but who so far as could be determined from the records had never been re-examined or been given a definite diagnosis one way or the other. These patients were not known to the various social service departments of these institutions, nor had they ever been referred to any central office for purposes of record. It is clearly evident that these 338 patients who are now classified as unknown are in urgent need of home visiting and re-examination. This is a group of patients which ought not to exist, and which if it must exist, should be reduced to the lowest possible figure. The following are two striking examples of what may happen, and indeed what has actually happened, to some of these neglected provisional cases:—

Case A. This patient was given a provisional diagnosis of pulmonary tuberculosis in an out-patient department July 22, 1920. He was entirely lost track of until reported November 4, 1920, by a private physician. He died fifteen days later, November 19, 1920.

Case B. In this case a provisional diagnosis of pulmonary tuberculosis was made at one of the out-patient departments June 15, 1920. He was

not heard from again until he was reported by another hospital, April 6, 1921, as having a chronic fibroid phthisis.

At a meeting that I asked Dr. F. X. Mahoney, health commissioner of the city of Boston, to call to consider this subject, representatives of the administrative staff and of the social service departments of the six institutions concerned were present. The question was raised as to whether the problem of the tuberculosis suspect was really as big as my figures appeared to make it. There was a feeling that after all the majority of these suspects would turn out not to have consumption. This is a pleasant and optimistic attitude but unfortunately not a sound one. The mere fact that of the 140 suspects in whom the diagnosis was finally settled one way or the other, 69 per cent. turned out to have pulmonary tuberculosis, is sufficient to demonstrate that the problem is a real one.

What are we going to do about it? Various points are absolutely clear and certain to me. In the first place, my investigations demonstrate clearly the advantage of the "one man" or "two man" special clinic. The number of patients with a provisional diagnosis who never showed up again was infinitely greater at those general out-patient departments and dispensaries where everything medical is thrown into one large group with doctors in attendance, serving three or four months, than it was in the special clinics where lung cases only are seen, and where the same man or the same group of men are in attendance all the year round. At the clinic of Dr. E. O. Otis, for instance, where at the Boston Dispensary he has been in charge for years, there were few such provisional diagnoses, as was also the case, I am glad to say, at my own clinic at the Massachusetts General Hospital.

Next to this, and of no less importance in solving this problem, I would mention the social service departments. Everyone of these "Tb. suspects" should be automatically referred to the social service department for home investigation and particularly to see that the patient returns for further examination.

Finally, there should be some department or organization which should act as a clearing house to keep track of these patients. I would suggest, for instance, that as soon as such a provisional diagnosis is made, the patient's name and address be recorded at this central office just as positive cases now are. A record of such provisional cases coming from various dispensaries or hospitals in the city would give much more information concerning them than we now have and would prevent much duplication of effort and would permit of their being checked up should they go to another clinic.

The provisional diagnosis of tuberculosis is an unsatisfactory one and one which ought not to exist in large numbers. Some such system as I have outlined above I believe will help to reduce the number.

FAMILY TUBERCULOSIS

By The Staff of the Framingham Demonstration

Framingham, Mass.

Family tuberculosis is a subject of etiology which is of interest because of the discussion which has arisen as to the time of tuberculous infection, and even whether or not all tuberculosis is of infantile origin.

There have been studies of family relationship worked backwards from the sanatoria, but so far as we know no community study of family relationships. Therefore it has seemed desirable to present the conditions found in Framingham, where for the past five years the community has been under close observation to try to detect the presence and origin of all cases of tuberculosis. Our machinery has become fairly well developed Beginning with two campaigns for general physical examinations there followed the draft, the influenza epidemic of 1918, the establishment of various clinics in the schools and factories, together with the awakened and intelligent interest in the subject by the local physicians, which has made it possible for the medical consultant to see a very large proportion of the broncho-pulmonary cases which have developed through the years.

As a result of these agencies, there have come to the notice of the Demonstration 406 cases which have been considered as tuberculous. This list includes both active and arrested cases and also a group whose connection with the town has been more or less transitory, even some of the draft cases being reported back to Framingham from far distant places.

The number of such cases materially reduces the real tuberculous cases residing in the town. Of the total group of 406 considered, there have been 200 men and 206 women, while the number of actual deaths from tuberculosis has totaled 100—divided between males and females 49 and 51 respectively. This is interesting, as in New York the proportion between male and female deaths is so great as to make a recent writer quoting Drolet speak of tuberculosis as "primarily a man's disease."

While as a practical administrative matter more men die of tuberculosis and more beds have to be provided for male patients, may it not be possible that the female morbidity is as great as the male—with more arrests—which gives a smaller death rate but an equal or even greater possibility of spreading the disease to the children and neighbors?

Of the 406 persons on our list of whom we have to take cognizance, there are 224 persons who have been married, representing 216 families. Children have been born into 164 of these tuberculous families, the 164 families being, so far as we know, represented by 456 children—or nearly three children to each of these 164 families. Thirty-two of the 456

children have developed tuberculosis including two children in one family whose mother and father have had tuberculosis.

In eight instances out of the 224 married people it was found that both husband and wife in the same family had at some period tuberculosis—a percentage of 3.5. This number of cases of possible marital tuberculosis is less than that reported in a recent study of sanatorium cases by Dr. S. Tillisch of Sweden who makes the number in over a thousand cases investigated as 6.2, while Barnes reports that of 229 widowed patients of the Wallum Lake Sanatorium 40 per cent. reported tuberculous consorts. Our small number is close upon the limits of tuberculosis incidence in the community.

In this group of eight families where both husband and wife had developed tuberculosis there were 26 children, but among these 26 children in only one family has tuberculosis developed. In this family, in spite of the fact of good economic surroundings and apparent carefulness on the part of the parents, two children have developed the disease and another has recently become a suspect.

Of the 406 cases under discussion, 87 individuals, so far as it has been possible to learn, have had family exposure, classified as follows: marital—5; children developing tuberculosis having contact with parent—32; brother, sister or some other relative who has been in intimate contact with the patient—50. These 87 individuals are concentrated in 55 families. Further investigation regarding these 55 families showed that there were 53 additional tuberculosis cases in the same families, which had developed in children either previously to the coming of the Demonstration, or who were now living in other towns of the State, or who had died. Thus these 55 families have furnished 140 instances of tuberculosis.

We have no families upon our list showing many cases of tuberculosis—such families as were common in the reports of investigators of the latter part of last century, but the following case is of interest. In the first year of the Demonstration a man 51 years of age died of pulmonary tuberculosis. He was the father of six children. The history in this case is not well known but the man had apparently been ill for only a few years. After his death his wife, 58 years of age, developed unmistakable tuberculosis. She was considered a suspicious case of tuberculosis a few months preceding her husband's death and developed signs of the disease the following year. She is still living and has occasional hemoptysis; apparently has slight activations but does all her own housework. A daughter 22 years of age developed unmistakable signs of tuberculosis one year following the death of the father. The history states that this girl had been ill only a few weeks before discovery of her disease was made. At present she is a far advanced case of tuberculosis with bad prognosis. One son, 24 years of age, developed unmistakable signs of tuberculosis two years after the father's death. This man had been in the war service. He had always lived at home preceding the war. At the time of discovery had active advancing disease but claimed he had been ill only for a few

weeks preceding his going to a physician. Has been steadily progressive since that time and is a far advanced case of tuberculosis with poor prognosis. One other son in this family, an out of town resident, is said to be a suspicious case of tuberculosis. This family lived under good economic conditions and has always been well cared for. Two children and the mother developed active tuberculosis less than three years from the death of the father who had probably not been ill with active disease until a few years preceding his death.

One of the writers of this paper recalls that in Framingham, during the decade of the seventies, there were a number of large families, mostly the children of emigrants from Ireland that were practically wiped out by the White Plague. In a generation previous to this there was reported to be a similiar condition among the so-called native stock.

The Demonstration for the first years of its existence considered that family relationship was a practically negligible quantity, but as time has gone on our studies have found that there are about one-fifth that show family contact and that in these 55 families there have occurred at some time or other 140 cases of tuberculosis.

The question may be asked. is there any reason for the change in the amount of family tuberculosis? One can only assert, leaving aside the question of acquired immunity and of susceptibility of race stocks, that there has been a great increase in the standard of living in the past fifty years. There is not the over crowding and the sleeping in the same bed, and there are better heating facilities and better ventilation than twenty years ago, and far better water supply, and consequently easy facilities for cleanliness. While conditions are by no means perfect as yet, nevertheless they have all helped to make direct contact with patients less dangerous. Add to this the result of community education since the general recognition of tuberculosis as a contagious disease, and the reasons for a diminution in family group tuberculosis is obvious. There should also be considered the provision for patients in hospitals and sanatoria which has gone on to such an extent that in Framingham there are fourteen patients at present in institutions out of fifty active cases known to the Demonstration. Each of these factors has tended to diminish the danger of family contagion which nevertheless still remains a real causative agent in the spread of tuberculosis as instanced by the fact that the history of fifty-five families shows no less than 140 cases of tuberculosis.

CONTINUED OBSERVATION IN PULMONARY TUBERCULOSIS AMONG NEGROES

By H. G. Carter, M.D.

Burkeville, Va.

The purpose of this report is to record the results of treatment of pulmonary tuberculosis among the Negroes in such a way that an intelligent comparison of these results obtained can be made with those of institutions admitting whites. This report covers the period of time from April, 1918 to September 30, 1921, and includes all patients discharged from Piedmont Sanatorium up to that time. Our observations cover the immediate results of treatment in the Sanatorium, the ultimate result as shown by our follow up work, the difference in results obtained in the "pure bred" Negro and the "mulatto," and the effect of syphilis complicating tuberculosis.

It was the original purpose of the institution to admit only the early case of tuberculosis, but on account of a total lack of local sanatoria in the rural districts of our State we found it necessary to admit a limited number of more advanced cases for the purpose of segregation. We now admit all cases applying for admission with the understanding that after two weeks' observation they will be returned to their homes if found to be in a hopelessly advanced stage. The only exception to this rule is in the case of those whose home conditions make institutional segregation imperative. While it is not the ideal arrangement to have a far advanced case of tuberculosis travel to and from a State Sanatorium in order to be classified, we find it necessary at times, and feel that with the lack of rural public health nurses the intensive training given the patient in the proper handling of sputum, dishes, etc., during the short stay more than counterbalances the harmful journey. We have admitted 204 cases of this type, 84 of whom died in the sanatorium and 120 were discharged as progressive. The average length of stay of this type of case was 67 days. In our follow up work as of March 1, 1922 we find that all of these 120 have died or are listed as not answering.

We have admitted for treatment 517 patients with results as follows:

TABLE 1

CONDITION ON ADMISSION		CONDITION ON DISCHARGE							
		Non-tuberculous	Suspicious	Apparently arrested	Quiescent	Improved	Unimproved	Progressing	Dead
Non-tuberculous	5	5	.....	.....	.....	.....	.....	.....	.....
Suspicious	11	.....	11	.....	.....	.....	.....	.....	.....
Incipient ....S	57	.....	.....	28	13	b 10	4	2	.....
Moderately Advanced	156	.....	.....	15	50	55	17	14	5
Advanced	288	.....	.....	2	35	77	13	127	34
Total	517	5	11	45	98	142	34	143	39

It will be noted from the above table that 301 or 58 per cent. improved under treatment and 216 or 42 per cent. showed no improvement or died in the institution. This table fairly well represents the type of case admitted in the average sanatorium admitting patients for treatment and includes all classifications. The average length of stay of patients included in this table was 103 days.

In our follow up work we find 196 or 41 per cent. of the 478 patients who were discharged improved and unimproved to be living March 1, 1922. One hundred and sixty-five or 35 per cent. we were unable to trace and 117 or 24 per cent. have died since leaving the sanatorium. The number living represents 27 per cent. of the total number of patients discharged from the sanatorium, including those admitted for segregation, and 41 per cent. of those discharged from the sanatorium who were admitted for treatment and discharged living.

Dividing these 196 patients living according to stage of disease:

TABLE 2

Condition on Admission	Number Admitted	Living	
		Number	Per cent.
Incipient. .	57	55	94
Moderately Advanced	157	69	44
Far Advanced	288	72	25

Summing up this work and recording same by the year discharged, and including all cases admitted to the sanatorium and discharged living:

TABLE 3

Year	Total Number Discharged Living	PRESENT DISPOSITION		
		Living	Dead	Unable to Trace
1918	66	17	39	10
1919	181	44	102	35
1920	166	68	63	35
1921	185	67	33	85

Twenty-six per cent. of all patients discharged in 1918 are living, 24 per cent. of those discharged in 1919 are living, 42 per cent. of those discharged in 1920 are living and 36 per cent. of those discharged in 1921 are living. These percentages, it should be recalled, include those admitted for segregation and discharged progressive as well as those admitted for treatment. There is a large percentage from whom no reply could be obtained and undoubtedly a certain percentage of these are living. The most significant figure in this phase of our work is the very large percentage of far advanced who die within a short period of time after leaving the sanatorium. Only 25 per cent. of 288 patients admitted for treatment as far advanced cases are living; these patients have been away from the sanatorium for periods ranging from six months to four years. Contrast this percentage with 94 per cent. incipient and 44 per cent. moderately advanced living, and the importance of publicity work emphasizing the recognition of early tuberculosis is apparent. Given a far advanced case of tuberculosis in the Negro and even with a short stay in a sanatorium his chances for ultimate recovery are slim, due to lessened resistance, unsuitable occupation and home environment, and inability to grasp the seriousness of his condition.

A routine Wassermann in our institution shows 12 per cent. of our patients to have a 4+ Wassermann, 2 per cent. with negative sputum and 10 per cent. with positive sputum. All patients showing a 4+ Wassermann are given anti-syphilitic treatment unless there is some marked contraindication for treatment. We have noted improvement in some with dual infection following treatment and exacerbation in some, the majority show slight or no affect. In those showing negative sputum and positive Wassermann the majority have improved under treatment. The improvement following anti-syphilitic treatment in those cases with positive sputum and positive Wassermann as well as those with slight or questionable pulmonary lesion with negative sputum and positive Wassermann could be attributed to improvement following constitutional

treatment for syphilis. But in the series of 16 cases with negative sputum and positive Wassermann there are 4 cases which we have definitely classed as pulmonary syphilis for the following reasons: definite and marked pulmonary lesions; 4+ Wassermann and negative sputum with profuse expectoration; marked improvement in chest findings and general symptoms following treatment.

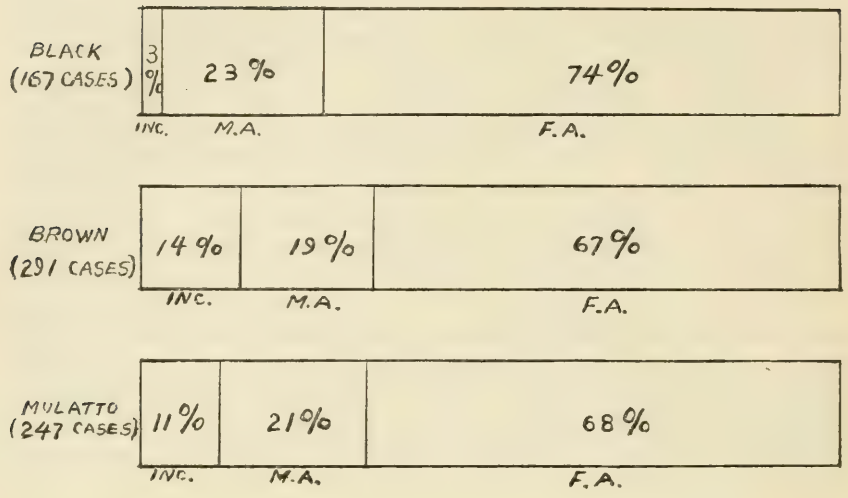
In our follow up work we find 9 patients living out of a total of 71 with positive sputum and positive Wassermann, this is slightly over 12 per cent. On the other hand there are 29 per cent. of our patients living with positive sputum and negative Wasserman. This will indicate that dual infection renders prognosis more grave. Some authors make a distinction between the prognosis in those cases in which syphilis is grafted on an old tuberculous lesion or tuberculosis is grafted on an old syphilitic lesion, saying that the former renders prognosis more grave and the latter more favorable than a simple tuberculous infection. We have been unable to determine with any degree of precision which infection antedated the other. However, our experience on the wards and our follow up work would lead us to the conclusion that dual infection with tuberculosis and syphilis renders prognosis more grave than a simple tuberculous infection.

TABLE 4

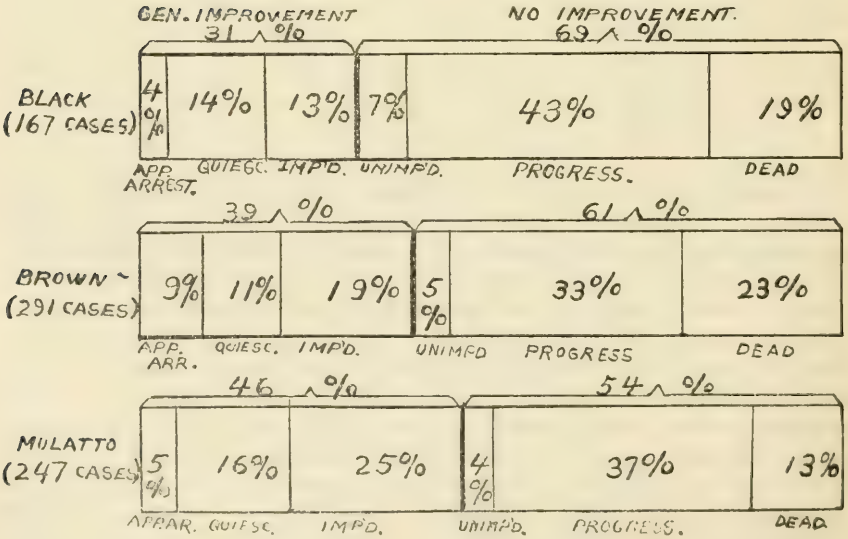
Age Group	Number Admitted
10 - 19	189
20 - 29	285
30 - 39	154
40 - 49	76
50 - 59	14
60 - 69	3

As shown by table 2 our records show disease at an average younger age than is shown by sanatoria admitting whites. We have a far greater percentage of "the young adult type" of tuberculosis which according to Brownlee would indicate lessened resistance on account of absence of contact. Our average age is twenty-two years and four months. Our greatest number of cases occur between twenty and thirty which is double those between thirty and forty. Most institutions for whites show an average age between twenty-eight and thirty-four. This would indicate that the "young adult" type of tuberculosis predominates in the negro, which being true, according to Brownlee, the inference would be that the high death rate in the Negro race would be due to the lack of resistance rather than unhealthful surroundings. The "middle age" type, according to the same writer, is the product of infection and re-infection in congested areas. A very small percentage of our patients come under the "middle age" type.

Condition on Admission



Condition on Discharge



Our observations continue to show the mulatto to have apparently better resistance than the black. Our division into the three classes, does not, of course, follow any hard and fast rule; those who are decidedly black are classed as *black,* those decidedly light are classed as *mulatto,* all other shades are called *brown.* One hundred and sixty-seven were put in the first or black class, 247 in the second or mulatto class, and 291 in the middle classification made up of many shades. I was not convinced in my last report, that the apparent better resistance shown by the mixed type was not a run of favorable cases in a small series. The number is larger in this report and I am now of the opinion that for some unknown reason the mixed type of Negro has a better resistance against pulmonary tuberculosis than the pure bred. Our tables showing results are no more conclusive than our bedside observations.

We have included in this report all cases admitted to the Sanatorium and it will be noted that there is not a very marked variation between the percentage of incipient, moderately advanced and far advanced in three classes. Seventy-four per cent. of blacks were far advanced, 67 per cent. brown and 68 per cent. mulattoes. There is, however, a wide variation in the percentage showing improvement. Thirty-one per cent. black were discharged improved, 69 per cent. unimproved; 39 per cent. browns improved, 61 per cent. unimproved; 46 per cent. mulattoes improved and 54 per cent. unimproved. In our bedside observation we find very few of the long drawn out cases among those progressive in the blacks. We do find them quite often in the mixed type.

A report from our institution would not be complete without emphasizing the interdependence of the two races of the South. Our records show that 75 per cent. of our patients follow an occupation that throws them into intimate contact with the white man's family, usually in the capacity of cook or nurse girl which offers so many opportunities to infect the family with tuberculosis. From a purely selfish point of view it is as necessary to prevent the spread of tuberculosis in the Negro race as it is in the white if we expect to lower the mortality rate in the white race in the South. We can cite numerous instances of intimate prolonged contact in childhood as the crux of disease in later life.

SUMMARY AND CONCLUSIONS

1. The results at our institution prove beyond question that the Negro, although he shows less resistance against the disease than the white man, will respond to treatment for pulmonary tuberculosis, and that if treatment is begun in the early stages of the disease the large percentage of them will continue well.

2. Syphilis complicating tuberculosis renders prognosis more grave than the simple tuberculous infection. Syphilis as a disease of the lung has been demonstrated by us in four clear cut examples in a series of sixteen with negative sputum and positive Wassermann.

3. If the "young adult" type of tuberculosis is indicative of lessened resistance on account of absence of contact, then our records will go to show that the high death rate from pulmonary tuberculosis among Negroes is due to absence of contact rather than unsanitary surroundings.

4. Our records continue to show the mulatto to have a better resistance against pulmonary tuberculosis than the pure bred. We offer this as a fact without any deduction regarding the significance thereof.

DISCUSSION ON PAPER BY DR. CARTER

Dr. H. R. M. Landis, Philadelphia : I am very much interested in this paper of Dr. Carter's. It is a subject to which I have been devoting a good deal of time and attention for the past eight years, and I do not believe that any tuberculosis program can be considered complete which does not take into account very fully and definitely the problem of tuberculosis in the Negro. Also, as he has shown and as our experience has been, the problem of syphilis in the Negro is a very important one. Most Southerners have realized for many years that they have this very serious problem on their hands. In the North, there is a lack of interest in it, and there is no realization that there is any such thing as a Negro problem.

The State of Pennsylvania has the largest Negro population north of the Southern States, and the City of Philadelphia, so far as I know, has the largest urban Negro population in this country, numbering something like 140,000. It is perfectly evident, with a race in which the death rate is so enormously high, with a morbidity rate that must be amazing, if we assume that for every death there are ten living cases, what an enormous amount of disease you have at all times in this race.

The results that Dr. Carter has shown have been borne out in an entirely different line of work, by what we have been able to do in Philadelphia by the utilization of Negro nurses and physicians, namely, educational work. This has resulted in getting them into the dispensaries and bringing home to them a realization of the problem that they have to deal with. We have had exactly the same experience as Dr. Carter with the combination of syphilis and tuberculosis in the same individual, and we have had also, a certain number of cases that certainly seemed to be syphilis of the lungs or instances of latent syphilis with respiratory symptoms.

It has been traditional to assume for years that the mulatto was an individual who had very poor resistant powers; that he inherited the weaknesses of both races; and this has been accepted as true for years. The first individual who ever questioned its truth was Clifford Allbutt, at the opening of the Eugenic Conference in London several years ago, when he pointed out that the mulatto had a much better resistance than the Negro. Although I have no specific evidence to quote, I am perfectly convinced that what he said is perfectly true.

I would urge those who live in the North where there is a Negro population of any size to take cognizance of the fact that this problem is one of the most important things you have to deal with. It is no longer true in the North and West that there is no Negro problem. In the past few years there has been an enormous migration of Negroes to the North and West, and there are many states in the North and West that have the problem as much as they have in the South.

Dr. Edward O. Otis, Boston: Dr. Carter mentioned the fact that among his list were four clear cut cases of pulmonary syphilis. I wish he would give us his evidence on which he makes his diagnosis. As we all know, it is a very difficult thing, if not an absolute impossibility, to make a diagnosis of pulmonary syphilis.

Dr. Oscar O. Miller, Louisville: The treatment of tuberculosis in the Negro in Louisville, Kentucky, has been particularly discouraging.

During the year 1920—1921, 147 colored patients were admitted to the institution for treatment. Eight per cent. were incipient cases, 41 per cent. moderately advanced and 51 per cent. far advanced. Of these 147 cases, 86 or 58.5 per cent. died within three months, and 61 or 41.5 per cent. were discharged against advice.

Of the 61 cases discharged 26 died at home, 24 were lost and, therefore, we were unable to report on them. This leaves 11 cases for consideration. Two of these were readmitted to the institution with the disease advanced, 5 cases were working full time and were apparently better, 4 were able to work but were not working.

Out of 147 cases only 6.2 per cent. can be considered as benefited by sanatorium treatment. The conclusion is obvious and resolves itself into a question of getting the Negro early.

The incipient cases without râles in the apex do relatively well. When we find them with moderately coarse râles extending to the third rib, the prognosis in our experience seems to be unfavorable.

Dr. Carter: In regard to the pulmonary syphilis, the diagnosis was made entirely by the therapeutic test; every case showed a 4+ Wassermann and negative sputum for tubercle bacilli after repeated examinations; all of them had a syphilitic history and showed a far advanced lesion which cleared rapidly under anti-syphilitic treatment.

Dr. Otis: What did your x-ray show, doctor?

Dr. Carter: In these cases, unfortunately, we did not have an x-ray picture.

I want to say to the doctor from Louisville that if he will adopt the plan of putting on Negro nurses in the wards to do the actual contact work I believe he will get a better spirit of cooperation from the patients. It is my experience that the actual contact work is better done by Negro nurses. This is also the experience of Dr. Landis of Philadelphia and Dr. Grandy of Norfolk.

THE MECHANISM OF HAEMOPTYSIS

By Edward N. Packard, M.D.

Saranac Lake

The vascular system is early attacked in pulmonary tuberculosis and forms one of the important pathological manifestations of the disease. The lumen of the vessels about the focus are usually obliterated by endarteritis but frequently the process is incomplete and rupture of the vessel wall may occur and hemoptysis result. The hemorrhage may be due either to erosion of the vessel wall, or to the rupture of an aneurismal dilatation of an artery. Very often the patient believes he has "done something" to start the bleeding; and clinically hemoptysis often occurs in close relationship with physical strain of some sort. A few observers have found it convenient to classify hemoptyses into two groups: those unattended by exertion and those associated with or occurring shortly after exertion. Thus Bang[1] in a study of 354 initial hemoptyses found that 70 per cent. occurred when the patient was lying down or reclining in a chair and that only 30 per cent. were associated with the various acts of strain, such as rising from bed, walking, straining at stool, climbing stairs, etc. However, the exertion associated with the act of coughing is not mentioned by Bang as a causal factor in hemoptysis.

In this communication I desire to confine attention to hemoptyses associated with physical strain. It is generally stated that such hemorrhages are due to increased blood pressure in the pulmonary circuit. This theory is based on the fact that exertion is known to raise the systemic blood pressure, and this observation has probably led to the supposition that the pulmonary blood pressure is likewise affected. Experimentally, however, it is difficult to show that marked variations in pulmonary blood pressure actually occur. On account of the inaccessibility of the pulmonary vessels in man, the exact pressure values and variations are unknown and must remain more or less a conjecture. Studies of the pulmonary circuit in dogs, however, may be accepted as a fairly accurate guide to the conditions existing in man.

It has been found that the various factors or forces which come into play during an act of strain have probably very little direct effect upon the pulmonary circulation. During such acts, such as straining at stool, parturition, lifting heavy weights, and so forth, the breath is held and pressure is made against a closed glottis. This may raise the systemic blood pressure 30 or 40 mm. Hg. The left ventricle, under such circumstances, meets an increased peripheral resistance and may be

unable to empty itself completely and thus a back pressure effect is exerted on the pulmonary circulation. The phenomenon might be presumed to give rise to an increased pulmonary blood pressure and pulmonary congestion, but the work of Henderson and Prince,[2] Straub,[3] Wiggers[4] and others, shows that the heart accommodates itself to the heightened arterial resistance by distention of the left ventricle. This distention of the ventricle in turn causes a deflection of the ventricular septum to the right with a consequent reduction in the size of the right ventricle and the volume of its systolic discharge. Aside from an insignificant increase in the blood volume of the lungs, the pulmonary circuits, according to Straub, remain entirely unaffected. In other words, a "back pressure effect" is overcome by the simultaneous operation of two factors—the increased working capacity of the left ventricle and the mechanical reduction in the systolic discharge of the right ventricle.

Another compensatory factor is brought into action when an increased volume of blood is pumped into the pulmonary vessels by the right heart. The momentary rise of pressure in the pulmonary veins stimulates the left ventricle to more powerful contractions and so maintains a constant lung blood pressure. Conversely, when the output of the right heart is considerably diminished, the left ventricle responds with a disproportionately decreased contraction. Thus the lungs are never drained of their blood, nor are they congested by every day acts of exertion, provided the heart functions normally.

The mean pulmonary blood pressure is much lower than the systemic, the ratio being 1:6 or 1:7; it is not subject to such degrees of variation in pressure as the systemic and its flow is characterized by a greater steadiness. The statement, found in many textbooks, that sudden elevations of pulmonary blood pressure occur and thus cause hemoptysis is not supported by experimental evidence, and Wiggers, in a personal communication, states that he very much doubts that hemoptysis is ever preceded by, or due to, an increase in pulmonary blood pressure directly.

However, even though we allow increased pulmonary blood pressure a part in the production of hemoptysis, still there are other mechanical factors of particular importance in this regard, to which I desire to draw attention. The first is the effect of marked variations in intrapulmonic air pressure upon eroded and weakened vessels—either venous or arterial—brought about by an act of strain. During quiet breathing, this variation is extremely small, but upon sudden exertion the intra pulmonic air pressure may be increased one hundred fold; that is, equal to the weight of 135 cm. of water. The termination of this act of exertion is the opening of the glottis, the sudden release of the imprisoned air and a drop to less than atmospheric pressure as a deep breath is taken. Now in the case of a lung cavity containing a disease-weakened vessel, whose internal blood pressure is around 25 mm. Hg, can we not conceive a rupture, or the hastening of a rupture, through this circumstance of an abrupt and marked variation of external pressure? Might not this same

force be a potent factor in the forming of aneurismal dilation on unsupported blood vessels? Similarly, in the paroxysms of cough the mechanical forces employed are identical with those used during any other act of strain. This fact, disregarded by Bang in his statistical study of hemorrhage, may account for the relatively low percentage of cases noted by him associated with exertion.

Another mechanical factor which may play a part in the causation of hemoptysis is the stress and strain upon disease-weakened vessels by movements of adjacent portions of the normal lung. Morbid areas with lost elasticity are frequently anchored to the chest wall by pleural adhesions. During cough, the contiguous zones of healthy lung exert an active tug on the diseased areas and thus subject the weakened vessels to an untoward strain. Furthermore, the sudden enlargement of an antrum under excessive intrapulmonic air pressure tends to attenuate the blood vessels and therefore must be regarded as an important predisposing factor in rupture of the vessel wall.

Hemorrhage ceases with the formation of a clot over the point of rupture and in the adjacent bronchi. If now, from excessive strain, commonly the result of cough, the intrapulmonic air pressure be suddenly and markedly raised, one can readily visualize that this would dilate the bronchus, dislodge the clot and cause a recurrence of the bleeding.

Whether or not this be the actual explanation of recurrent hemorrhage, clinical observation points unmistakably to the fact that it often follows directly in the wake of cough.

The mechanical factors above mentioned, namely, sudden and great variations of external air pressures upon weakened blood vessels; the stretching of these diseased vessels by excessive lung movements, as occurs during paroxysms of cough; and the dilatation of a bronchus with dislodgement of blood clot, appear, to the mind of the writer, to be better explanations of the cause of hemoptysis during, or following, strain, than sudden elevations of pulmonary blood pressure.

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DISCUSSION ON PAPER BY DR. PACKARD

Dr. Louis C. Boisliniere, St. Louis: I should like to ask Dr. Packard just one question. In explaining the mechanism of hemoptysis, the factor of congestion must necessarily play a very important part. I think that all of us, or a great many of us at any rate, have been able to predict an imminent hemorrhage by the markedly increased second pulmonary sound. On several occasions among my patients this prediction has been verified most dramatically.

Another thing, during the period of menstruation, which is necessarily a period of congestion, how can we explain pink stool that occurs, unless we must admit a very necessary factor in the mechanism of hemoptysis, that of pulmonary congestion?

Dr. Packard: In regard to congestion, I carefully sidestepped that point; I tried to bring out the question of hemorrhage associated particularly with strain. The cause of the hemorrhage occurring from areas of congestion in the lung is still a problem. Some believe there is a toxic factor, others believe that it is due to diapedesis from the vessels. A frank hemoptysis must be due to erosion or rupture of the vessel wall. In my paper I had in mind particulary those cases where there is a large or small antrum formation.

SURGERY IN TUBERCULOSIS

By A. M. Forster, M.D., G. B. Webb, M.D., and G. B. Gilbert, M.D.

Colorado Springs

We have always considered it axiomatic that surgery is to be avoided in the tuberculous. At the same time, we have been sensitive to the criticism that sanatorium men are inclined to treat only the pulmonary condition and to neglect or overlook other conditions which more or less seriously affect the patient.

In consequence, it occurred to us that it might be of interest to analyze our recent cases in regard to the number and nature of surgical operations performed on them. We have chosen for this analysis the last five hundred consecutive cases remaining in the institution a sufficient length of time for accurate diagnosis and observation, i. e. at least two months.

Excluding artificial pneumothorax, and such cases as furuncles, extraction of teeth, etc. we have had twenty-nine surgical operations among the five hundred cases.

These twenty-nine cases were as follows:

Induced abortion (dilatation and curetage) (Pregnancy less than 3 months)	4 cases
Caesarian section (Pregnancy over 3 months)	2 cases
Surgical collapse	3 cases
Ischio rectal abscess	1 case
Ovarian cyst	1 case
Cholecystectomy	1 case
Appendectomy	4 cases
Tonsilectomy	7 cases
Radical maxillary sinus	3 cases
Submucous resection	1 case
Intubation	1 case
Unerupted teeth	1 case
Pneumothorax	29 cases

Induced Abortion for the Interruption of Early Pregnancy

Of the four cases of this condition, one was a primipara, while the other three were multiparae. In each case the symptoms of tuberculosis were active and progressive and of sufficient gravity in our judgment to warrant the surgical interference. In three of the cases, the symptoms sub-

sided and there was no extension of the lesion after operation. In the fourth case, the symptoms have subsided but the lesion is worse.

Caeserian Section

Of the two cases under this heading, one was very far advanced, with active symptoms and a tuberculous larynx. The symptoms cleared up very quickly following the operation and there was no evidence of a spread of the lesion.

The other case was moderately advanced but the symptoms were markedly active. Following the operation, the symptoms gradually subsided but the patient was left with a very definite extension of her lesion.

As opposed to the above, we have had two cases of pregnancy among the five hundred, which in our judgment did not warrant surgical interference.

One was a multipara with a limited pulmonary lesion and very slight symptoms. She improved during pregnancy, had a normal easy labor and has remained in good condition for some sixteen months.

The second case was in a primipara with a moderately advanced pulmonary lesion. Her symptoms began to improve following conception and it was our plan to allow her to go to term and then perform Caeserian section. However, before coming under our observation she had had a decapitation of the cervix and apparently this led to abortion at the sixth month. At present, six months following the abortion, her condition is no worse.

Surgical Collapse

We agree most heartily with those who hold that this operation is not one of last resort.

The first case in this series was in a young man who had taken artificial pneumothorax with poor result on account of extensive adhesions. The operation was undertaken at his urgent request and with the feeling that the prognosis was very poor. He made a satisfactory recovery from the operation but with poor symptomatic results. His death occurred some months later following an emergency operation for acute cholecystitis.

The second case was that of a young female well nourished and in good general condition. The left lung was involved throughout with cavity formation in the upper lobe. There was a well limited fibrosis in the right upper lobe. Pneumothorax was unsuccessful on account of adhesions. The operation was performed seven months ago with excellent symptomatic results. The temperature was quickly reduced from 101, which had been the average for months previous, to normal, and the sputum from four ounces to practically none. Other symptoms improved correspondingly. The cavity signs disappeared although there

has been, as always, a surprising amount of movement on the operated side, and râles have persisted.

The third case was also in a woman with physical signs practically identical with the above case. Her symptoms were milder but she was in constant fear and danger from repeated hemorrhages seemingly associated with the menstrual period. This case was operated on four months ago and there has been no further haemoptysis. Her temperature does not go above 99 and her cough and expectoration are markedly reduced.

Ischio Rectal Abscess

We have resorted to operation in only one case of this kind. This was in a patient who suffered intense pain from a fistula. In two other cases developing while under our care, prompt drainage and heliotherapy resulted in healing. We do not include these in our list of surgical cases.

In two other cases with old sinuses dating back from one to three years, the condition has yielded to thorough drainage, injection of bismuth paste and heliotherapy.

One other case is still under treatment.

Ovarian Cyst

This case occurred in an extremely neurotic young woman with a mild pulmonary tuberculosis. Her abdominal symptoms rather pointed to duodenal ulcer, but the x-ray failed to confirm this diagnosis and appropriate treatment gave no result. The increase in her alleged abdominal pain, persistent nausea and vomiting and the development of a loukocytosis led us to consent to the surgeon's advice for operation. A left ovarian cyst was discovered with a mild sub-acute non-tuberculous appendicitis. There was no ulcer. The operation was performed two months ago. At present the lung signs are slightly more extensive and the indefinite abdominal pain persists. In this case the element of hysteria is prominent.

Cholecystectomy

This case is cited above under the heading of surgical collapse. Operation was resorted to for the gall bladder condition because of the acuteness of symptoms. Death followed within two weeks as a result of the debility caused by the long continued tuberculosis and the two operations.

Appendectomy

One of these cases is reported above under the heading of ovarian cyst.

The second case occurred in a patient with moderately advanced pulmonary tuberculosis. The symptoms were extremely acute with a history of previous milder attacks. The appendix was full of pus. Recov-

ery was uneventful and there was no increase in physical signs in the chest.

The third case was in a patient with far advanced pulmonary tuberculosis with very active symptoms. In the course of six months, he had two acute abdominal attacks and when the third developed he was operated on. A tremendously indurated appendix was found but it was full of pus and of course there was no question as to the necessity for operation. There was no evidence of tuberculosis in the abdomen Following the operation, the right lung rapidly grew worse, but with the institution of pneumothorax, the symptoms quickly subsided and the man has remained well for a year and a half.

The fourth case had a beginning tuberculosis of the appendix and cecum. The appendix only was removed, and heliotherapy instituted The patient has remained without symptoms for over a year.

Needless to say, we have had among this group a large number of cases complaining of more or less severe digestive disturbances. Possibly many, but for the pulmonary condition, would have come to operation. In addition to the four cases operated on, we have had five cases diagnosed as appendicitis after consultation with the surgeon. Operation was deferred on account of the condition of the patient. These cases occurred from eight months to three years ago and so far no ill results seem to have come from our decision.

Of course, we do not mean to say that we have not had still further cases, but we feel that our natural desire to avoid operation has led us to use palliative treatment, and that our results justify this course.

We have had sixteen apparently definite cases of tuberculous enteritis, eight of whom died. In the fatal cases, the enteritis was an end complication. Of the other cases symptoms have been in abeyance for from ten months to three years. We have had two cases of tuberculous peritonitis, both of whom had been operated on previously and in both of whom there were discharging sinuses. In both, heliotherapy seemed to clear up the condition.

Sinus—Three Cases

We now come to a group of cases in which we are strongly tempted to ask the aid of surgery. Infections of the upper respiratory tract unquestionably have a peculiarly bad effect on the lung condition and frequently palliative treatment is of little avail. We have carried out operation on the sinuses in three of our cases.

The first was a case of mild peribronchial tuberculosis with recurrent "colds." Both maxillary sinuses were cleaned out and the patient made a most excellent recovery.

The second case was that of a patient whose tuberculosis was of many years' standing. The pulmonary symptoms were more those of a chronic bronchitis. The maxillary sinuses were curetted and both found badly diseased. The operation was performed four months ago and

the patient has made definite improvement, although we have no right to expect a cure.

The third case was that of a patient whose physical signs and symptoms were typical of bronchiectasis, although her sputum contains tubercle bacilli. Both antrae and the frontal sinuses were found badly diseased. She has made definite improvement since the operation.

Tonsilectomy—Seven Cases

We have performed tonsilectomy in seven cases. In six cases there were repeated colds and sore throats and tonsil massage either failed or gave only partial relief. In none of these cases after a period of three months to two years, do we feel that any damage was done to the tuberculous condition, and the symptoms caused by the tonsils have been cleared up. The seventh case was that of a patient with far advanced quiescent pulmonary tuberculosis complicated by tuberculous laryngitis. We delayed operation as long as possible, but acute recurrent attacks of arthritis finally forced the issue. Her tuberculous condition was not apparently harmed and the rheumatism cleared up.

Submucous Resection—One Case

In this case the patient had a very badly deviated septum which made mouth breathing a necessity. His freedom from colds and the improvement in his chest condition after a year are marked.

Gastric and Duodenal Ulcer—Five Cases

We have had five cases diagnosed as ulcer in all of whom symptoms yielded to medical treatment.

Genitourinary Tuberculosis—Three Cases

We have had three cases of tuberculous kidney. In one both kidneys were involved and the condition remained under control with treatment by heliotherapy. The patient has since passed out of our charge.

The second case had had the right kidney removed eighteen months before admission to Cragmor. The entire incision had broken down and there remained a discharging wound six inches long and four deep. The dressings had to be changed several times a day. The bladder symptoms were very severe. In six months under heliotherapy only a small sinus with practically no discharge was left, the bladder symptoms had subsided and the patient had gained thirty pounds.

In the third patient after a year of heliotherapy, there are no symptoms.

We have had three cases of tuberculosis of the testicle. In the first case castration was advised but refused. The effect of heliotherapy was quite striking, and for a year and a half there has been no discharge and no other evidence of activity.

The second case had far advanced pulmonary tuberculosis as well as a tuberculous ankle joint. He died three months after admission.

The third case is now under treament with heliotherapy. The condition shows marked improvement.

In three cases of suspected genitourinary tuberculosis the diagnosis was not confirmed but the patients were found to have colon bacillus infection of the prostate and seminal vesicle. They cleared up under massage and autogenous vaccines.

Tuberculous Joints—Three Cases

We have had two cases of sacroiliac tuberculosis. In both we secured excellent results with plaster casts and heliotherapy. The third case is mentioned above under genitourinary tuberculosis. He had tuberculosis of the ankle joint but was practically moribund on admission.

Cold Abscess—Three Cases

The first case had a slightly fluctuating mass on the posterior aspect of the arm which showed no evidence, x-ray or otherwise, of connection with the elbow joint or with the humerus. The pus was withdrawn and iodoform emulsion injected. Heliotherapy was instituted and the condition improved. The patient left our care before the case was completed.

The second case had a fluctuating mass about four inches in diameter over the second rib in front. He had been treated by removal of the pus and injection of iodoform emulsion for months previous with no apparent improvement of the condition. We continued this treatment but added heliotherapy. In four months time, the mass had completely disappeared and there was no return up to the time of the patient's death from acute nephritis, five months later.

The third patient came to us several months after a resection of a small portion of the fourth rib in front. We were unable to secure a report of the pathological findings and we were unable to confirm the diagnosis. She had a discharging wound four inches long extending down to the rib. This closed in two months under heliotherapy and there has been no return after six months more.

Tuberculous Cervical Adenitis—Two Cases

In both of these cases the glands were markedly enlarged and growing in size. After approximately a year's treatment with sunlight the glands were reduced to negligible size and have remained inactive for from one to two years.

Artificial Pneumothorax—Twenty-nine Cases

We do not deem it wise to take up your time with a detailed discussion of these cases, but simply quote the number we have had.

Spontaneous Pneumothorax—Three Cases

We have had three cases of this condition. The first had no symptoms and the collapse was discovered on routine examination. He has returned to his home and reports himself in good health after three years. The left upper lobe only was collapsed. The second case occurred during the course of artificial pneumothorax treatment. He suffered extreme discomfort until the pressure was reduced by removal of air. He had no bad effects and the treatment was continued. He has remained symptom free for over a year.

The third case developed the condition en route and came in with terrific dyspnoea and tachycardia. He was promptly relieved by removal of air. He is under treatment and his general condition is markedly improved although the ultimate prognosis is bad.

We feel that much of our success in avoiding operations as well as with our operated cases, is due to our surgical consultants.

In a community like ours, made up to so large an extent of tuberculous individuals, the surgeon has learned to say "no." But further than that, when he does operate, he does everything to save time and avoid shock. He fully appreciates the value of choosing the best time for operation and is always more than willing to co-operate in every way with the medical man. Almost of as much importance, is the anesthetist. In Colorado Springs, all our anesthesias are given by graduates in medicine who devote themselves entirely to this specialty. We feel very strongly that their skill and knowledge of anesthesia in the tuberculous are indispensible. We also feel that the sanatorium with its opportunities for proper after care is an important element.

We feel that it greatly diminishes the chance of harm resulting from surgery if the time of operation can be chosen, so that the patient is in the best possible condition to recover from the inevitable shock.

We feel that there is the least chance for harm and the greatest for good in operations for conditions of the upper respiratory tract, provided, of course, that a favorable time is chosen.

We feel that abdominal surgery is particularly contra-indicated in tuberculosis.

Although we have a large proportion of tuberculous laryngitis, in no case in this series have we undertaken any operative procedure.

Conclusions

The axiom that surgery is, if possible, to be avoided in the tuberculous, still holds good.

The doctor who has such control over his patient as is the rule in tuberculosis should make every effort to see that surgery does not become necessary through neglect of medical treatment.

The surgeon who operates on tuberculous patients will profit by the closest co-operation with the medical man.

It is our feeling that surgery of any sort is, if possible, to be avoided in the tuberculous, but that this is particularly true of surgery for tuberculous conditions.

On the other hand, the above figures prove that we recognize the fact that the rule has many exceptions and that error on the one hand may be as grave as on the other.

We feel that where local anesthesia is not possible, gas oxygen should be given, but that a great deal also depends on care and skill in administration.

We feel that every sanatorium should have an operating room in order that after care can be carried out under the best conditions.

DISCUSSION ON PAPER BY DR. FORSTER, DR. WEBB AND DR. GILBERT

Dr. Edward O. Otis, Boston: I think it would be very interesting if Dr. Forster would tell us what criterion he adopts to permit him to give general anesthesia in a case of tuberculosis—how much disease, what condition of the disease, etc., and when he considers that only local anesthesia should be employed in these surgical cases. In my experience, it is extraordinary how much tuberculous disease can exist in the lungs and yet the patient do perfectly well when put under general anesthesia.

Dr. Lawrason Brown, Saranac Lake: Couldn't we hear a word from Dr. Archibald who operates a great many?

Dr. Edward Archibald, Montreal: That is very kind of Dr. Brown, I am sure, but there is a very long program on and I must not take more than a moment.

Briefly, if I may state my own beliefs as to anesthesia, I am altogether in favor of gas oxygen combined with local novocain. I have never seen gas oxygen do any harm, except possibly in one case in which it was not well taken and in which the patient breathed very deeply and struggled somewhat. That man had a flare-up afterwards which might possibly have been attributed to the anesthesia. After that experience I did not hesitate to instruct the anesthetist, if anything like that happened, to add the merest trifle of chloroform.

As to local anesthesia alone, I do not believe in it, except for small things. The patients are weak physically and we must not put them to any particular strain. The gas does not harm them but it gives them mental anesthesia—which is not produced by local anesthesia—as well as pain anesthesia. I notice, by the way, that Sauerbruch, who used to do all his rib resections under local anesthesia alone, has given it up in favor of ether. In Germany, apparently they haven't gas or don't know much about it. Willy Meyer, in New York, has given up perivertical anesthesia, as I heard from him the other day. In the last analysis, gas

oxygen, I think, combined with local, comes down as the proper anesthesia.

As to the extent of disease in the lung, I have operated successfully with gas oxygen on a good many cases with very extensive disease on both sides, with or without cavitation, with extreme fibrosis, with even a considerable degree of dyspnea.

Dr. C. D. Parfitt, Gravenhurst, Ont.: Six years ago, before this Association, I reported some thirty-five cases of pulmonary tuberculosis which underwent extensive surgical operations. Excepting in three very severe cases, abdominal sections (two of them intestinal tuberculosis and one of them gastro-enterostomy), none of them suffered any harm. I attribute this mainly to the fact that a minimal amount of ether was used; in nearly all cases gas oxygen anesthesia combined with local anesthesia was used and in a few chloroform; rarely a little ether was necessary. I am confirmed in my opinion that whenever there is something relievable by surgery that will benefit the patient, something should be done.

Dr. Robert H. Babcock, Chicago: I simply would like to ask if, in the use of gas oxygen, these surgeons also use what I have been in the habit of calling the rebreathing method, where the patients breathe back their own carbonic acid? The only two patients I have ever lost on the table, received pure gas and both of them died of acapnia, and since then I insist that the gas oxygen should be used with the rebreathing method.

Dr. Forster: The question was brought up by Dr. Otis, as to the rules for the use of general anesthesia, and Dr. Archibald answered that for us also. We feel that with properly given general anesthesia, using the gas oxygen, there is so small an element of danger, that we possibly offset a good deal of the nervous shock to the patient when local anesthesia is used. However, if we have a patient who has a steady nerve and who has an operation which will probably not entail any great amount of shock, naturally we prefer to use the local anesthesia.

I don't quite feel like saying, as strongly as Dr. Archibald did, that we never see any ill effects from the use of the anesthetic. In the detail of this paper I show some cases where we have felt that the patient derived harm from the operation, or from the combination of operation and anesthetic. I don't know that it is possible for us to differentiate between whatever harm comes from the shock or as a direct result of the operation, and how much harm may come from the anesthesia.

Dr. Babcock raised the question of the rebreathing method. That happens to be the method used by our anesthetist and it is invariably followed.

OBSERVATIONS IN THE TREATMENT OF PULMONARY HEMORRHAGES BY ARTIFICIAL PNEUMOTHORAX

By M. J. Fine, M.D.

Newark, N. J.

I am aware that this subject has been brought to your attention before and through iteration and reiteration has lost a good deal of its novelty, yet because of its practical importance, it may be interesting to you to analyze the findings of individual observers at the last analysis. Knowledge can only be accumulated and established through the means of the findings of the individuals. It is a well known fact that mechanical pressure outside the lungs will stop a hemorrhage more effectively than treatment with medicine. Equally effective mechanical pressure is obtained by an injection of air into the pleura. This causes a partial collapse of the affected lung. As I shall show later, it is not always possible to determine exactly the seat of the hemorrhage before proceeding with the induction of an artificial pneumothorax, but it is well to remember that in cases well advanced, when the lungs are usually filled with blood, a great number of gurgling râles can be heard which are usually more pronounced on the side where the hemorrhage is located. Very seldom does bleeding take place from both sides at the same time.

I am convinced that after an injection of air, the development of a hydropneumothorax is not especially detrimental and I dare say a slight hydropneumothorax, which usually does occur in this work is desirable. The lung is maintained in a collapsed condition, the hemorrhage invariably ceases and if no infection develops, there is nothing disadvantageous in this condition.

Furthermore, in febrile cases where the patient insists upon being active and refuses the rest treatment, I have noticed that the induction of an artificial pneumothorax will effectively stop the hemorrhage and permit the patient to be about.

In afebrile cases, it is frequently claimed that hemorrhages are rarely fatal, but in my experience I have seen such cases where complete exsanguination resulted. I therefore, suggest that in cases of hemorrhage, no matter how grave or slight, if the usual medication does not result in its stoppage, an artificial pneumothorax should be induced. I wish to state at this point that one induction of an artificial pneumothorax has almost always resulted in completely checking the hemorrhage and very rarely did I have to resort to a second induction.

I have seen patients where exact diagnosis was impossible, and where the exact location of the hemorrhage could not be determined. An induction of an artificial pneumothorax is sometimes of a decided benefit, even when the pressure was exerted on the opposite side from which the bleeding occurred. For in such cases, it would seem the pneumothorax exerts a material pressure indirectly through the lung tissue on the opposite side. Even in cases gravely advanced, where extensive cavitation and ulceration have taken place bilaterally, an induction of an artificial pneumothorax with its resulting mechanical pressure will check the hemorrhage. Furthermore, it may cause the collapse of this cavity and thereby give the lung an opportunity to heal. It must, of course, be admitted that sometimes in such cases the hemorrhage will cease and yet the progress of the disease may continue and the patient will eventually die.

I wish to say a few words with regard to the induction of an artificial pneumothorax in patients where pleural adhesion has taken place. It is sometimes claimed that the induction of a pneumothorax in such cases is undesirable. In my own experience, I have had cases with pleural adhesions where I was at first unable to induce an artificial pneumothorax; but after finding a location which was free from adhesions, I succeeded in inducing air in the pleural cavity, and as in all other cases, the resulting mechanical pressure effectually stopped the hemorrhage. In other words, I hold that the induction of an artificial pneumothorax should not be abandoned in these cases. Repeated attempts should be made, for very recent pleural adhesions may gradually give way to the pressure.

The wisest course is to give the minimum quantity. Especially is this rule to be observed in gravely advanced cases where the mediastinum is weak and where there is a possibility of causing a spontaneous pneumothorax on the healthy side. I have found that 300 c.c. of air is the maximum amount desirable in the ordinary case. In case No. 10, for instance, had I administered 300 c.c. as usual, the life of the patient would probably have been prolonged.

From the cases which have come under my observation, I have selected the following as the best illustration of the views I have expressed above.

Case No. 1.—Electrician, American, age 40; sick three years, expectorated about one dram of blood every morning; never thought he was ill; sputum negative for two and one-half years; lesion was located on the right side, involving the entire upper lobe. I gave him 250 c.c. of air, bleeding stopped. Seven days later when I attempted to refill, I found that he had developed a hydrothorax. Medicine had no effect on the bleeding.

Case No. 2.—School teacher, American, age 31; tuberculous for about two years. Lesion involved both apices; the left being more active. Patient first developed a hemorrhage when out of bed and insisted upon going about and being active. 300 c.c. of air was given on the left side. Bleeding stopped. I kept up the air twice a week for curative purposes.

Case No. 3.—Garment worker, Russian, 65 years old; brought to the hospital while having a hemorrhage. It was very profuse and alarming; medicine had no effect. It was impossible to make out the condition of the chest from the examination. There were a great many gurgling râles over both chests. I gave him 300 c.c. of air on the left side. Bleeding immediately stopped. Two days later streaks of blood appeared in the sputum. I gave him another injection of 350 c.c. in the same side, but on examination more gurgling râles were found on the right side. There was no more bleeding, patient was sent to the sanatorium for advanced tuberculosis, but refused to stay; returned home. At present is feeling fine.

Case No. 4.—Banker, Italian, 42 years old; patient's first symptom was a severe hemorrhage; he never knew he had any trouble; lost about an ounce of blood at first and continued bleeding; medicine had no effect. Chest was filled with blood and it was impossible to make out the exact lesion but on examination more gurgling râles were found on the right side. I injected 300 c.c. of air in the right side; the hemorrhage stopped but started again three days later; I gave him 400 c.c. and bleeding entirely stopped; condition was bilateral but more extensive on the right side. His condition since has improved a great deal.

Case No. 5.—Glass blower, Russian, 33 years old; has been in hospital five weeks; came in with a tuberculous pneumonia. Patient's general appearance was good, condition of chest showed a moderately advanced lesion which extended over the entire right side and the apex on the left; bleeding continued for two days, quite extensively; usual treatment was of no avail. I gave him 350 c.c. on the right side, bleeding stopped. When sent to the sanatorium he had occasional streaks of blood. Expectoration though, was profuse.

Case No. 6.—Laborer, Italian, age 24; came to hospital with a hemorrhage, expectorating about a dram of blood every hour. The next day the hemorrhage was more severe. The lesion was confined to both apices. I attempted to induce air on the right side posterially but could not succeed in getting into the pleural cavity because of a thickened pluera. Two days later the hemorrhage became very much worse, I attempted to inject air anteriorally on the right side and succeeded in getting in, I gave him 200 c.c. Bleeding stopped immediately.

Case No. 7.—Ex-soldier, 23 years old; chest condition quite advanced; had been under regular treatment about four years. Lesion very extensive on right side and left apex. Started to bleed, I gave him 300 c.c. of air in the right side, bleeding stopped. Continued with this treatment, twice weekly for about three months; patient got along very nicely for about a year but now his condition is much worse.

Case No. 8.—Laborer, Austrian, age 40; had been sick for two years; admitted to hospital in a moribund condition; lesion in chest advanced; cavitation on right side and extensive ulceration on left side; while in bed with a high fever, he developed a hemorrhage. Gave him 300 c.c.; patient stopped bleeding; condition gradually became worse and a month later he died.

Case No. 9.—Factory hand, American, age 32 years; came to hospital expectorating about three ounces of blood every morning; the onset of his condition was about three months previously; he then had a hemorrhage of one-half cup of blood; lesion in chest confined entirely to right side. While in the hospital the hemorrhages became more severe. I gave him 500 c.c. The hemorrhage stopped but he contined to have streaks of blood in his sputum. A month later he had another hemorrhage. I gave him again 500 c.c. of air, bleeding stopped but streaks occasionally appeared in sputum. Two weeks later he had another hemorrhage, when I gave him 800 c.c. of air. A week later patient was sent to a sanatorium; there was no blood in sputum.

Case No. 10.—Cloak operator, Italian-American, 20 years old; patient sick about three years; brought to hospital in dying condition; both lungs literally shot to pieces, patient expectorating a great deal of blood. I knew that he could not be saved but thought I might prolong his life, and gave him 1200 c.c. of air; the hemorrhage stopped, the patient felt better; a few hours later the patient complained of a pain in his chest, which had come on suddenly, followed by dyspnoea and a few minutes later the patient died. Death was probably due to spontaneous pneumothorax on the opposite side.

I wish to conclude with the statement that in only one case of those in which I administered air to induce an artificial pneumothorax, have I noted an unfavorable sequel. This good fortune I attribute to the wholly beneficial effect that the induction of an artificial pneumothorax exerts.

A highly nervous patient, where a collapse of the lung is indicated, will often refuse an artificial pneumothorax in fear that he will become worse. When, however, a hemorrhage results he will permit the physician to do almost anything in an attempt to stop the bleeding. If the first injection has been successful the confidence of the patient is gained and he will permit the continued application of this treatment, as a curative measure.

The Chairman: We shall have the next three papers dealing with the subject of pneumothorax presented and have the discussion on all four papers at the end.

THE CLINICAL SIGNIFICANCE OF ALTERED INTRATHORACIC EQUILIBRIUM IN PNEUMOTHORAX WITH SPECIAL REFERENCE TO OPTIMUM PRESSURES

By Barnett P. Stivelman, M.D., Herman Hennell, M.D., and Harry Golembe, M.D.

Bedford Hills, N. Y.

In a recent publication entitled "Intrathoracic Equilibrium in Pneumothorax,"[1] we have discussed in some detail the mechanics and dynamics of this problem. In the present communication we purpose to re-state as briefly as possible the fundamental ideas of the earlier contribution and to discuss in some detail the other phase of the subject, namely, the clinical effects of the altered intrathoracic equilibrium in pneumothorax.

Graham and Bell,[2] in their excellent monograph on the subject of pneumothorax have touched the heart of the problem, when, after a thorough review of the literature on pneumothorax and careful experimental studies in the laboratories at Johns Hopkins University, they have come to the conclusion that: "From the standpoint of pressure relations, the thorax may be considered as one cavity instead of two. Any change of pressure in one pleural cavity will affect also the other one almost equally. The common conception of collapsed lung on one side and 'healthy' or 'normal' lung on the other in the condition of open pneumothorax in the otherwise normal chest must be erroneous." This, they prove, applies as well to closed pneumothorax in chests relatively free from adhesions.

This fundamental conception has been corroborated by Simon[3] and Bechov[4] in their experimental studies on the effect of pneumothorax on the pressure conditions in the untreated side in men and laboratory animals; and the results of our own experiments in a small but carefully studied series of rabbits also support this view.

Clinically, the phenomenon of the so-called "movements of balance" i. e. the inspiratory displacement of the mediastinum towards the pneumothorax side and the paradoxical movement of the diaphragm), the mechanism of which we analyzed in considerable detail in our previous communication, are perhaps the best illustrations of the delicacy with which the intrathoracic equilibrium is adjusted in pneumothorax in the presence of a flexible mediastinum and an inert diaphragm.

Our conclusions on the subject were, therefore, as follows: In the presence of a flexible mediastinum, the intrathoracic equilibrium in pneu-

mothorax is very delicately adjusted, and any disturbance in the intrathoracic pressure on the treated side will have a proportionate effect on the intrathoracic pressure on the untreated side as well as produce a readjustment in the position of the mediastinal structures. On the other hand, with a mediastinum effectively fixed by adhesions, the effect of unilateral pneumothorax on the opposite side is practically negligible. For the rigid mediastinum will stand the brunt of the increased intrathoracic pressure on the pneumothorax side without transmitting it to the untreated side.

Bearing these fundamental principles of pneumo-dynamics in mind, we may now consider the clinical effects of the altered intrathoracic equilibrium in pneumothorax.

It is apparent that when the pneumothorax is localized by extensive adhesions, or the mediastinum effectively fixed, or both, high positive intrapleural pressure, even up to 40-50 mm. of Hg. will cause no appreciable effect on the pressure conditions of the opposite side or the size and function of the untreated lung. Under such circumstances, as high pressure as can be borne in the particular case may be given in the presence of a therapeutic indication.

Such an indication exists particularly in cases where the symptoms and signs point to a tendency toward obliteration of the pleural cavity, whether or not this occurs as a result of a complicating hydropneumothorax. Experience has taught that such pleural obliteration can be avoided in some cases and delayed in others by the judicious recourse to gradually increasing positive intrapleural tension. Unless this procedure is resorted to in these cases, a loss of pneumothorax will occur, the affected lung will rapidly re-expand, laying open the diseased foci and excavations, for the very relief of which the lung was collapsed. The danger of this re-expansion is particularly great because, once lost control of and given a chance to progress, pleural obliteration will preclude the possibility of resuming successful collapse therapy. It is unfortunate, indeed, that in some of these cases the pressure cannot be raised high enough because the gas under pressure escapes through the needle puncture into the adjoining and often surrounding subcutaneous tissue. And while pressure of plus 30-50 mm. of Hg. may occasionally cause some adhesions to rupture, this unfortunate occurrence is not frequent enough to warrant an abandonment of this procedure in most cases.

It is different in the case of a flexible and labile mediastinum. Here increased intrapleural pressure on the pneumothorax side means not only proportionate increase of pressure on the opposite side but also a definite compression of the untreated lung. With one lung collapsed and the untreated lung somewhat involved, as it usually is in many cases subjected to collapse therapy, every effort should be made to embarrass as little as possible the untreated organ which is now forced to perform the function of respiration practically unaided. Many of our failures in pneumothorax are, no doubt, due to the reactivation of tuberculous foci

in the untreated lung which might have been avoided by a more thorough appreciation of the pneumodynamics involved.

In these cases of bilateral involvement we must endeavor by patient observation to determine the amount of compression which the untreated lung can stand as a result of the increased intrapleural pressure on the treated side. Indeed, this is the most difficult problem to solve in cases that fall in this category.

Those who are most competent to judge have long realized that there is no such thing as a standard optimum pressure, even in the simpler pneumothorax cases. Each patient is a law unto himself. A pressure which is sufficient to bring about an arrestment of the disease in one case may be distinctly injurious in another. There was a time when we aimed to establish a positive pressure of about 4 cm. of water at the fourth inflation in all cases. We know of a patient who would have lost his life as a result of a telephone order to induce a positive pressure of 4 cm. had it not been for the quick action of the assistant, who, realizing the distress of the patient, withdrew some air by using the simple expedient of lowering the gas reservoir, i. e., reversing the syphonage until the patient was relieved. No dogmatic statements are possible, although it is generally observed that the best results are more frequently obtained when the intrapleural tension can be maintained at about 2-3 cm. of water, or as it has recently been called "partial collapse." In such cases the affected lung is usually effectively collapsed and the untreated lung, by virtue of the flexible and labile mediastinum, is but lightly compressed.

Evidence is accumulating to the effect that this light compression of the so-called untreated but somewhat diseased lung, is of entirely salutary nature. The progress of the tuberculous foci which are thus compressed may be definitely arrested, and even areas of consolidation and cavity formation are often beneficially affected. We count among our outstanding successes many patients whose untreated lung was definitely and often actively affected prior to the induction of pneumothorax on the opposite, more diseased lung.

When, on the other hand, the intrapleural pressure is rapidly increased in such cases and the mediastinum is markedly displaced towards the untreated, less affected lung, forcibly compressing it, the threshold of safety is soon passed and deleterious effects are not long in appearing. The crowding of the untreated organ and the great amount of atelectasis produced in it may endanger life by the marked diminution in the respiratory function of the only working lung. Furthermore, the great decrease in negativity in the intrapleural pressure on the untreated side must be overcome by more strenuous inspiratory efforts. These factors, added to the existing disability of the already overworked organ, sooner rather than later, fan the flame of activity, which, if not quickly recognized and promptly relieved, soon passes beyond our control.

Among the very few therapeutic indications for a slight positive pressure, even in the presence of a flexible mediastinum, may be mentioned

the existence of thick walled active vomicae and hemoptysis. However, in compressing for hemoptysis, contrary to general belief, it is not always necessary to create high intrapleural pressure. It is an accepted fact that most hemorrhages arise from branches of the pulmonary veins, which, as a rule, are easily compressible. When the bleeding is due to an erosion of an aneurism of Rasmussen traversing a rigid walled cavity, no amount of pressure applied through the medium of pneumothorax may suffice to ligate it. There are exceptions to this rule and in such cases, after trying a zero pressure, it may be necessary in view of the emergency to resort to higher pressures.

It is not generally appreciated that the circulatory apparatus is profoundly and unfavorably affected in cases where the mediastinal structures are markedly dislocated. As it has been shown, a diminution in the negativity of the intrapleural pressure at once interferes with, if it does not completely destroy, the aspiratory factor in the venous blood return which can be compensated for only by increased cardiac action. The dyspnoea and cyanosis attending marked mediastinal displacements are in a great measure due to cardiac embarrassment and perhaps kinking of some of the larger vessels.

Experience has taught that although the heart will tolerate a great deal of dislocation and accommodate itself to its new position and altered intrathoracic pressure, if these take place gradually, it will nevertheless be severely embarrassed if this new position and pressure relation are quickly changed. It is for this reason that severe cardiorespiratory failure and even death may occur as a result of sudden and marked disturbance of intrapleural tension following aspiration of copious pleural effusions. The rapid restoration of the intrathoracic equilibrium to which the heart had recently accommodated itself by the inflation of gas into the affected pleural cavity will in a few seconds relieve this distressing chain of symptoms and may even prevent a fatal issue.

SUMMARY AND CONCLUSION

The study of the pneumodynamics in general and its mechanism in pneumothorax, the experimental evidence on the effect of pneumothorax on the intrathoracic equilibrium, as well as the accumulated clinical experience, help us to formulate certain guiding principles in the management of pneumothorax cases as far as pressures are concerned.

In initial inflations and in the early refills, it is imperative to alter the intrathoracic conditions as gradually as possible. (It is our usual procedure to give the patient 200-400 c.c. at each of the first few refills, gradually lengthening the intervals from one to seven days, and cautiously raising the amount of gas and pressure). This allows the patient to pass through this period of compression with as little discomfort as possible. From the study of the signs and symptoms during this period as well as from the radioscopic appearance of the treated and untreated lungs, it is possible to determine the optimum pressure for each case.

In the presence of a flexible mediastinum, high pressure should at all times be avoided. A slight positive pressure may be given only in the presence of strong indications (hemorrhage, thick walled active vomicae). This principle is particularly adhered to when there is considerable involvement of the untreated side. Here again each case must be individualized and carefully observed.

Sudden changes in the intrathoracic conditions should never be permitted. For this reason all connections with the pneumothorax apparatus should be prearranged in aspirating hydropneumothorax cases, to enable us to reinflate quickly if necessary. Failure to do this may give rise to distressing symptoms and even lead to a fatal issue as a result of acute cardio-respiratory embarrassment.

In brief, our guiding principles in the management of pressures in pneumothorax are:

1. To avoid sudden change in the intrathoracic equilibrium and in the relative position of the intrathoracic viscera.
2. To avoid high pressures in the presence of a flexible mediastinum.
3. To increase, gradually but definitely, the positive intrapleural pressure in cases in which pleural obliteration is threatening.
4. To individualize the cases, determining the optimum pressure requirement of each.

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REFLECTIONS UPON NINE AND ONE-HALF YEARS' EXPERIENCE WITH ARTIFICIAL PNEUMOTHORAX*

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In 1917, my partner, Dr. Charles L. Minor[1], read a paper before this section on four and one-half years' experience with artificial pneumothorax. In it he reported upon one hundred cases in which an attempt had been made to compress the lung. It is my purpose today to glance back over our pneumothorax work done during the past nine and a half years and to see what impressions and conclusions can be reached as a result of constantly growing experience with the procedure.

It is no longer necessary to dwell in detail upon the indications for artificial pneumothorax. We find, however, that we are apt to try pneumothorax in milder cases than formerly, in those cases where the patient is stagnating instead of going definitely down-hill, or in those cases where a relatively small area of disease shows signs of increased activity or of spread. The following recent case is a good illustration of rapid increase in activity in a patient with slight physical findings and symptoms. Miss K. under treatment eight months and doing well, on January 22, 1922 began to have slightly streaked sputum and finally had small hemoptyses. Physical signs increased, cough and expectoration as well, x-ray showed corresponding changes and she began to run temperature. On February 22 pneumothorax was started. Excellent collapse was obtained with disappearance of all symptoms of cough, sputum and temperature. Now her condition is excellent. We are also more apt to try pneumothorax as a purely palliative measure in the hope of giving the patient comfort and relief.

Cases with apical involvement offer a better outlook for satisfactory compression than do cases with basal disease because partial collapse, so often beneficial, as will be pointed out later, is far more apt to be possible when the main seat of trouble is at the apex.

Cases of profuse hemorrhage give us some of our most brilliant results in artificial pneumothorax as in this form of treatment we possess the only direct means of arresting hemoptysis.

The technic has become more simple, and the process of giving injections less formidable than of yore. We find the preliminary injection

* Owing to the prohibitive cost of printing the half-tones, the illustrations furnished by Dr. Ringer have perforce been omitted.

of morphia almost never necessary. Occasionally a dose of aromatic-spirits of ammonia or of codeine has to be given after the injection.

Atmospheric air has been used exclusively. It works just as well as the nitrogen we so conscientiously used for years. We have not seen any benefits from using the warmed air recommended by some authors.

One point in the technic of injection has proven of value in my hands. It not infrequently happens at a first injection, that the proximal arm of the manometer will show a marked negative reading without fluctuations, when one feels almost certain that the point of the needle has penetrated the parietal pleura. If the needle is gradually withdrawn it is felt to slip out of the pleural cavity and the manometer falls to zero. I believe that this high negative, non-fluctuating reading denotes that the point of the needle is resting against the visceral pleura. When such a condition presents itself, if a minute amount of air (as much as can flow through the needle when the air-cock is opened for between a tenth and a fifth of a second) is allowed to flow, the viseral layer of pleura is pushed away from the point of the needle, and the characteristic free negative manometric fluctuations at once set in. I have noted this so many times that it cannot be merely a coincidence. The procedure is not dangerous in any way, and is of value in creating a pleural "space".

Refills are more frequent and less massive than they used to be several years ago. The more I see of pneumothorax the more satisfied I am of the advisability of this principle, based on the comfort and safety of the patient. Riviere[2] says: "It is not wise to let refills run above 700 or 800 cc and in most cases 500 cc. or less is a preferable amount." I find myself absolutely in accord with him. By allowing too long an interval between refills not only is excessive mediastinal shifting brought about, but the formation of adhesions in the costo-phrenic sinus is favored, which may easily become the starting point for obliteration of the pleural cavity. In the past three years I have had but two cases under my care that were allowed to go more than twenty-one days between refills.

In hemorrhage cases alone do we find justifications for the use of massive injections. I have often given 1000 to 1400 cc. at the first injection Here where we wish to squeeze down the lung sufficiently to occlude the bleeding point, small doses are useless, and may even prove harmful in a manner analogous to the tourniquet that is placed about a bleeding limb sufficiently tight to impede the venous return but not to cut off the arterial influx.

Pressure: As a rule the final air pressure as recorded by the water manometer need not be over plus 4 cm. Occasionally, as when a cavity remains persistently open, and it is believed upon fluoroscopic and radiographic examination that the adhesions can be stretched, higher pressures, up to 8 or 10 cm. of water are permissible. In one case, not long ago, I erred in not pushing the pressure up. The patient passed out of my hands, and a colleague profiting by my mistake in judgment, greatly increased the pressure and finally succeeded in compressing an apical cavity and in obtaining a total collapse.

I cannot protest too strongly against the practice of using high pressures with the object of tearing adhesions. This is most risky, as it is not known whether blood vessels are in the adhesions, and Jacobaeus[3] reports his only alarming experience as resulting from profuse hemorrhage occurring in the course of the cauterization of an adhesion. Furthermore, it cannot be foretold at which end the adhesion will tear if it does give way. The visceral extremity may tear, and in so doing lacerate the lung causing severe hemorrhage with a resulting hemo-pneumothorax. It is safe to stretch adhesions gently, but not to submit them to excessive tension.

The accidents incident to artificial pneumothorax seem to be becoming fewer and fewer. A search of the literature reveals but one or two reports of untoward occurrences. The bugbears of pleural shock and air embolism are becoming curiosities rather than dangers. Since the spring of 1919, I cannot remember a single alarming symptom appearing during or immediately after an injection. My experience, I am sure, will be duplicated by practically every worker in this field.

I believe the reasons for this satisfactory condition of things are twofold:

1. *Better anaesthetization of the field of injection especially of the pleural membrane itself.* This I feel is very important. If patients are not hurt they will not exhibit many of the purely nervous reflexes that formerly were attributed to the mechanical injury sustained at the moment of injection. It is claimed moreover that the reflexes causing pleural shock arise from the visceral pleura where there is luxuriant arborization of filaments from the pneumogastric nerve. If this theory be true the necessity of careful pleural anaesthesia becomes all the more apparent as at any first injection the visceral pleura is almost certain to be touched.

2. *Better manometric interpretation.* Unless the point of the needle penetrates the wall of a cavity and in so doing lays open the lumen of a vessel into which air can be aspirated with each respiratory excursion, prior to any air having been allowed to flow, there is no excuse for air embolism if the manometric readings are strictly observed and their simple meaning correctly interpreted.

CHANCES OR SUCCESS AND FAILURE IN ANY GIVEN CASE

There is nothing in which I have less faith than in my ability to foretell whether I will be successful in establishing an air space at the initial injection. When all is said and done, when stereograms have been taken and studied, when the respiratory motion of the pulmonary bases has been estimated and observed by percussion and under the fluoroscope, when the patient has been carefully auscultated and the presence or

absence of pleural frictions determined, when all this has been done, chances of success are very uncertain, and to quote Kipling,

"You never can tell 'till you've tried 'em
And then you are like to be wrong;
There's times when you think that you mightn't,
There's times when you know that you might."—

I am glad to see my opinion thus corroborated by Boas[4]: "physical signs and fluoroscopy will not always give assurance whether or not collapse of the lung is possible. In many cases all efforts to enter the pleural cavity are unavailing although no difficulty is expected."

TOTAL AND PARTIAL COLLAPSE

Were benefits derivable from artificial pneumothorax to depend upon total collapse, the method would before now have been looked upon as so rarely of service as hardly to warrant its general use. Fortunately partial collapse is productive of great good. Some of the cases showing most striking results have done so as a result of partial collapse only.

No better illustration of this fact could be given than the following case of Mrs. C. who had bilateral involvement by far most marked on the right with temperature to 102, a really terrible cough, much sputum, emaciation, night sweats, all the classical symptoms of advanced progressive tuberculosis. As a last resort artificial pneumothorax was tried. The result was miraculous. Temperature dropped, cough was greatly lessened as was sputum, appetite returned, and in every way marked improvement ensued. Now, one year after collapse, while not well, she is perfectly comfortable, goes about the house, can take motor rides and is able to enjoy life.

To be sure partial collapse will not bring about total disappearance of symptoms as will complete collapse, but partial collapse will very frequently do away with the symptoms of toxaemia such as fever, night sweats, anorexia, etc. The reason for this strikes me as being that often the site of greatest toxin absorption is not from the walls of a cavity but from the pericavernous lung tissue. This tissue will frequently be well collapsed while dense adhesions prevent the cavity from closing. Partial collapse proves of more service when the adhesions limiting it are apical rather than mesial or basal. The method of Jacobeus of cauterizing adhesions and thus converting partial into total collapse holds promise.

Bilateral collapse has from time to time been mentioned in the literature. It has been mentioned as being done simultaneously, and also as being done successively first on one side and then on the other at an interval of a few weeks or months. I have never been able to convince myself of the justifiability of this procedure and have never seen a case in which I was even tempted to try it. It has always struck me as riding a good horse to death, and as coming under the head of meddlesome interference.

COMPLICATIONS

The most frequent complication met with and the one that at present is offering the greatest subject for discussion and controversy is *fluid.*

Our views with regard to the appearance of fluid in the course of an artificial pneumothorax have undergone great modifications in the past few years. Its presence used to be looked upon as a beneficial occurrence, helping to preserve the collapse, lessening the frequency of refills, and save when becoming infected, productive of no harm. But with added experience, many cases are constantly seen that, having developed fluid, thenceforth do not get along as well. The great harm that fluid does is to favor the gradual obliteration of the pleural cavity from below upward, and to draw the mediastinum over toward the treated side. In an excellent paper read before this section last year, Stivelman and Rosenblatt[5] laid down the principle that in many cases the expectant form of treatment of fluid is not justifiable. In our work I have not encountered fluid as frequently as have many other observers. The common consensus of opinion is that it occurs in about fifty per cent. of the cases. I regret that my records are incomplete on this score, but I am certain that I have not encountered fluid in over twenty-five per cent. of the cases, unless one counts the ounce or two that often accumulates in the costo-phrenic sinus, that shows no tendency to increase, and that can be discovered only by the x-ray. In my experience these minute quantities of fluid do no harm. As I wrote in 1917,[6] I have for several years made it a practice always to aspirate any fluid reaching the fourth rib, and to substitute air. I think that in the future it will be wise to aspirate even smaller quantities. I have done this even in the absence of signs of retraction of the pleural cavity or of mediastinal shifting toward the treated side, which is the indication given by Stivelman and Rosenblatt. I do not differ with their indication in any way. The reason I have not followed it is that, my work not being under one roof, the bringing of patients to the office every time for roentgenological examination often proved too fatiguing for them.

As a corollary to this method of dealing with fluid, may be noted the marked tendency at present to substitute air for fluid after thoracentesis for cases of pleurisy with effusion.

APPEARANCE OF OR INCREASE IN ACTIVITY IN UNCOLLAPSED LUNG

This unfortunate complication is met with not infrequently by all doing much artificial pneumothorax work. The more careful one is in the selection of cases the rarer will be its occurrence. I am, however, of the opinion that in those cases in which artificial pneumothorax can be considered, and in which, unless compression is obtainable, the outlook is absolutely bad, the risk should be run and the patient given the chance, for occasionally surprisingly good results will be obtained in cases showing both radiologically and on physical examination evidences of considerable

activity in the relatively good side. These patients can often be helped palliatively and their remaining days made more comfortable.

DURATION OF COLLAPSE

This important matter is a difficult one to decide. In too many cases complications will decide it for us by forcing the discontinuance of injections. If no complications occur, the cases fall into three groups: 1. Cases with total collapse; 2. Cases with partial collapse; 3. Cases collapsed for hemorrhage.

1. Cases With Total Collapse

In my opinion compression should be maintained for at least two years and even longer. We have no way of telling when healing is complete, and a perfect collapse is too valuable an asset to be lightly dispensed with. Post mortem findings in such cases are too infrequent to permit of the formation of conclusions as to the time element necessary for permanent healing. Refills can now be so universally obtained that the question of the patient having to stay in one place does not enter into the matter. After two years or so it seems reasonably safe to allow re-expansion.

2. Cases With Partial Collapse

These patients should be refilled indefinitely. The collapse is not such as to bring about complete healing and the benefit derived from compression is to be obtained only as long as compression is maintained. If it is released, evidences of activity will almost invariably set in.

3. Cases Collapsed for Hemorrhage

This class of cases can further be subdivided into two:

a. Cases in which the opposite lung is free from disease. b. Cases in which the opposite lung is more or less involved.

a. Cases in which the opposite lung is free from disease:

We not infrequently see patients exhibiting profuse hemoptysis in whom we had not considered artificial pneumothorax prior to the advent of bleeding despite the fact that the process was wholly or mainly unilateral. If forced to compress the lung to control hemorrhage, the collapse should be continued as though it had been begun in the absence of any emergency, as thus both subsequent bleedings will be avoided and new areas of involvement as a result of the hemorrhage will be nipped in the bud.

b. Cases in which the opposite lung is more or less involved:

In these cases compression should be maintained only until such a time as we feel reasonably certain that the bleeding point is firmly plugged. I know of no guiding rule. I have however found, purely by experience, that from three to four weeks is a sufficient length of time to maintain the

collapse which should be kept under rather higher pressure than when done in the absence of hemoptysis. Needless to say, as this class of cases is unsuited for pneumothorax and the procedure is an emergency measure, the sooner the added strain upon the uncollapsed lung can be removed, the better.

ARTIFICAL PNEUMOTHORAX IN ABSCESS OF THE LUNG

My experience in this class of cases is small but at the same time most unsatisfactory. The one brilliant result that we obtained was, I think, back in 1912 in one of the first cases Dr. Minor and I ever did. A dying man was converted in a few weeks into a healthy vigorous individual who resumed his work and was eventually lost sight of. Other cases stand out in my memory in a very different light. In one a lung abscess that was being compressed burst into the pleural cavity with resulting death of the patient. In another practically the same thing occurred. In still another compression did no good and the patient eventually recovered, after having reached the brink of the grave and refusing surgical intervention, by the providential spontaneous rupture of the abscess into a bronchus. All in all I am not in favor of attempting to "squeeze out" an abscess of the lung by artificial pneumothorax. It is too much of a "hit or miss" method. Surgery is much better.

Cases of lung abscess seen really in their incipiency offer a much better chance of cure by compression than do those seen when fully established. I have not had the opportunity to try compression upon any early cases.

RESULTS

Brilliant though immediate results frequently are in cases treated with artificial pneumothorax, the cold light of statistics shows that the percentage of permanent complete recoveries obtained is disappointingly small. Boas, from an experience of six years at the Montefiore Home, confesses frankly that "positive cure is too rarely accomplished. Generally marked improvement sets in for a time, and then some complication supervenes which causes the disease to resume its course. The patient often gets a 'reprieve' of a year or two, and this means a good deal."

I would not want it to be thought that, as a result of almost a decade of experience, I consider artificial pneumothorax as of little avail. In some cases it will actually drag a patient out of the grave and restore him to permanent and complete health. In many cases it will help—will inhibit the advances of disease and will prolong life—but a glance at the tabulation of any fairly large number of cases covering a few years will show that by far the greater number are either dead or wholly incapacitated. Nevertheless artificial pneumothorax succeeds in a sufficiently large percentage of cases to warrant its continued use, together with constant searching for better technic and improved methods to make the procedure more complete.

In his paper in 1917, Dr. Minor reported on 100 cases of attempted artificial pneumothorax. Of his 100 cases, in 11 no entry was possible, and 44 were classified as failures mainly because of the presence of adhesions. I wish to report on 101 cases occurring in our practice in which at least definite partial collapse was obtainable, thus eliminating the failures in the sense of no pneumothorax being obtainable.

I have divided these 101 cases into five classes: 1. dead; 2. dying; 3. living; 4. well; 5. unknown.

By "living" I mean still in fair condition, but pursuing their cure and wholly incapacitated from work. By "well" I denote those that have achieved a symptomatic recovery.

Total Cases—101

Dead, 41; Dying, 5; Living, 25, Well, 14; Unknown,16.

Eliminating the "Unknown" class, there are left 85 cases upon which to base our results. Of these:

Dead, 41 or 48.2 per cent.; Dying, 5 or 5.8 per cent.; Living, 24 or 19.4 per cent.; Well, 14 or 16.4 per cent.

The five cases in the "Dying" class if added to the "Dead" class make a total of 54 per cent. as practically dead.

Among the 14 classified as "Well", three deserve special mention. Two recovered not because of, but despite their pneumothorax. In one not the slightest effect was produced, and another was a case of lung abscess which finally ruptured spontaneously after artificial pneumothorax had been abandoned and surgery refused. The third case, still under treatment, is a most remarkable one of spontaneous pneumothorax in an individual never having shown any symptoms of tuberculosis. The lung has expanded twice, only to have the pneumothorax recur. It is now being held down in the hope that the opening will permanently heal. Thus, subtracting the three cases just mentioned, there are but 11, or 12.9 per cent. of the 85 cases that owe their recovery to artificial pneumothorax, not a large percentage when we consider that these 101 cases were all individuals in whom at least a workable collapse was obtained. Twenty-five others however are still living, and of these 25, 16 while incapacitated from work, are enjoying fair health and are not bed-ridden invalids. This brightens the picture. Thus out of the 101 cases 14 are well and 16 able to lead a life greatly limited, it is true, but still not that of one hundred per cent. invalidism. This gives an aggregate of practically 30 per cent. showing marked improvement and freedom from absolute invalidism, surely a number amply justifying the use of artificial pneumothorax.

CONCLUSIONS

To epitomize very briefly conclusions reached as a result of nine and one-half years' experience with artificial pneumothorax, it can be said that

the method is valuable, and one which no man posing as an expert in pulmonary tuberculosis can afford to neglect. Its applicability will of course vary with the personal opinion of each one that uses it. To some the field will widen, to others it will contract. Personally I see the general sphere of applicability increase; the segment of permanent arrest contract. Immediate results are often surprisingly brilliant; percentage of really permanent arrests disappointingly small. Its use in hemorrhage is of the greatest value. It is often an immediate life-saver, frequently a life prolonger, not seldom a bringer of comfort and relative relief from distressing symptoms. Finally it is the one method at our command that offers to the far-advanced unilateral or relatively unilateral case a good chance of further longevity, and a reasonable chance of economic recovery.

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PLEURAL EFFUSIONS COMPLICATING ARTIFICIAL PNEUMOTHORAX: THEIR INCIDENCE, CHARACTER AND SIGNIFICANCE

By Andrew Peters, M.D., and J. Stanley Woolley, M.D.

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Since artificial pneumothorax has become a procedure more commonly adopted in the treatment of certain types of pulmonary tuberculosis, there has been wider opportunity to observe, not only its undoubted and frequently striking beneficial results, but also its more untoward complications. And of these, by far the most common, and the least perceptibly influenced by any modifications or refinements or technic, is pleural effusion into the pneumothorax space. This occurrence is indeed so common and often of such slight apparent import, that it is often overlooked and not regarded as a complication. This probably partly accounts for wide variance in the statistics of incidence reported by different operators.

In this paper we shall attempt to set forth in brief: first, the incidence of this complication as gathered from various sources of observation, with a differentiation of the various types observed; second, a presentation of a considerable series of clinical and laboratory observations made at Loomis Sanatorium; third, some of the views held as to its etiology, mechanism and consequences, with a running discussion; and finally, the conclusions arrived at from the entire data.

Forlanini[1] speaks of pleurisy with effusion as the most frequent complication of artificial pneumothorax, and says the co-existing pneumothorax gives it a special significance. As Beggs[2] says, this constitutes the great objection to recommending collapse early in the disease. Weiss[3] emphasizes the fact that the complication of pleural exudate must be reckoned on through the whole course of treatment. The occasional supervention of tuberculous empyema was early remarked by Brauer and Spengler[4] and Dumarest.[5] A review of European, English and American literature shows some divergence in statistics of incidence of effusions but as a general rule those whose observations have been most extensive and cover the longest time report the highest incidence. Perhaps 50 per cent. is the figure most frequently mentioned (Saugman,[6] Von Muralt and Zeigler,[7] (cited by Shortle), Rist,[8] Riviere,[9] Henius[10]). Sachs[11] in his compilation of the results of 24 American observers up to 1915, gives the reported incidence in something over 1,000 cases as 14.4 per cent. but adds that this figure must be considered too low, probably due either to the short period of many of the observations or to

the omission of small effusions from the records, and estimates the actual incidence at 30 to 50 per cent. Both Shortle[12] and Riviere have shown that the chance of effusion increases with the length of treatment, and the latter states that in partial pneumothorax it is less prone to develop. Paterson[13] in a recent article gives the incidence of this complication as 75 per cent., while LeRoy S. Peters[14] believes that nearly all cases will eventually show some effusion if observed long and carefully enough.

Several authors have brought forward evidence to show that the liability to effusion varies with the intensity and acuteness of the disease, notably Von Muralt and Shortle; the latter cites both his own statistics and those of Weinstein of Davos. Also Parfitt and Crombie[15] showed that two-thirds of their effusions occurring in the moderately advanced group were transitory as compared with 10 per cent. of those in the far advanced group. These observations should certainly very strongly suggest that the main cause of these effusions is to be found inside and not outside of the chest.

Classification of these effusions has been attempted by a number of authors on clinical, morphological or specifically etiological grounds. It must be recognized that one type frequently merges into another. The type accompanying or following a spontaneous pneumothorax, with demonstrable bronchial communication, should doubtless be placed in a special group, owing to the grave prognosis of this accident, which, however, in the Loomis Sanatorium experience has been comparatively rare. On the whole the clinical classifications appear more practical, as one can generally but infer what the underlying pathological changes are. Thus we have, according to Von Muralt, (1) mild serous transitory effusions, (2) slowly increasing effusions with tendency to chronicity, which may become purulent, (3) acute febrile pleurisies (these are the most likely to contain pyogenic organisms).

The evolution of a clear serous effusion into a tuberculous empyema has been remarked by a number of different observers, among the first of whom were Brauer and Spengler,[4] and has been most carefully described by Dumarest.[16] It is noteworthy that it may take place silently and after defervescence. It should be clearly differentiated from septic empyema, especially that due to acute lung perforation, the symptoms of which are much more acute and severe, and the prognosis much graver. Some authors still further insist on differentiating what they term a benign sterile empyema; but this is undoubtedly merely a mild tuberculous empyema in which the organisms are either extremely scarce or may have been destroyed. Jacot's[17] classification of purulent effusions is an interesting one and very practical from the clinical standpoint, but in the brief time allotted we shall not have time to go into it.

We will now cite the clinical observations made and recorded on 75 patients at Loomis Sanatorium who developed effusions complicating artificial pneumothorax, and then will follow the laboratory data on 36

patients, most of whom were of the same series but a few were studied afterwards.

INCIDENCE

Of 142 patients treated by artificial pneumothorax up to October 1921 and all started prior to April 1921, in whom an appreciable pneumothorax was obtained, 2 had pre-existing effusions; of the remaining 140 patients 75 (53.6 per cent.) developed recognizable pleural effusions during the course of treatment—quite possibly more, as it is likely that some small effusions may have been overlooked prior to the routine use of the fluoroscope, or considered too insignificant to mention. It should be remarked that 4 patients out of the 75 developed an effusion on more than one occasion, the interval being 12 months in one case, and 2 of these later effusions eventually became purulent. Of the 79 effusions reported in these 75 patients, 35 were of considerable degree (estimated to fill more than half the side of the chest), 28 of moderate degree, and 15 of slight degree, (confined to the base only). Most of the considerable effusions produced well marked symptoms and most of the slight effusions insignificant symptoms or none at all, but this was not invariably true.

The proportion of effusions which became purulent is of particular clinical interest—9 out of 75 cases (12 per cent). In these cases tubercle bacilli were usually found in large numbers (see laboratory examination). In 5 pyogenic organisms were recovered, and 2 had demonstrable bronchial communication with the pleura.

Incidence with respect to season or time of year:—

We naturally find considerable irregularity, but apparently a predominance in the last four months of the year, and also in March and April, while the least common month for effusions to appear was July. Of 79 effusions

27	occurred	during	first	four	months (January, February, March and April)
17	"	"	next	"	" (May, June, July and August)
35	"	"	last	"	" (September, October, November and December)

Interval between beginning of treatment and appearance of effusion:

60	(76 per cent)	occurred	within first six months
75	(95 per cent)	"	" first year
4	(5 per cent)	"	after the first year

Results of the Effusions:

Effects on course and progress of case—Immediate Effects:		
Pneumothorax discontinued: on account of effusion...	13	
Pneumothorax discontinued: on account of obliteration of pleural space.....	13	
	26	(34.7 per cent)
Pleural space contracted more or less.....	35	(46.7 per cent)
	61	(81.3 per cent)
Final results of treatment:		
Satisfactory	24	
Fair.	12	
Unsatisfactory.	9	
Palliative only	30	
Present Status:		
Living.	48	(64.8 per cent)
Dead.	26	(35.2 per cent)
Untraced.	1	
Condition satisfactory.	26	(35 per cent)

Comparison with Results in the Dry Cases:

If we go over all of our pneumothorax cases, relying solely on the bare figures, we find a slight advantage for the "wet group" both in proportion alive and proportion in satisfactory condition; but the figures are misleading in this respect—that a considerable number in the "dry" group were very unfavorable cases, in whom treatment was continued but a short time and discontinued for some other reason; unquestionably with a longer period of compression the number of effusions would have increased; therefore, these brief trials of "bad risks" among the "dry" cases vitiate our statistics; therefore all that can be said is that the end results in our effusion cases have been better than one might be led to expect in view of the limitations which they impose on the continuation of pneumothorax, and the unfavorable symptoms which not infrequently accompany or follow them.

Comparison of Cases Treated with Those Untreated: (by aspiration, replacement by air, etc.) (Here we can only give a very brief statistical summary)

	Untreated 15 (*in 14 patients*)	Treated 20 (*in 18 patients*)	
A.—*Considerable Effusions*:			
Pneumothorax discontinued	6	7	
Pleural space obliterated.....	4	0	
No apparent effect on space.....	0	3	
Living.	7 (50 per cent)	12	(66.7 per cent)
Condition satisfactory	3	5	(one under observation)
		2	still under treatment.

B.—*Moderate Effusions*	22	6
Pneumothorax discontinued	2	0
Pleural space obliterated	8	0
Pleural space unaffected	2	1
Living	17 (81 per cent)	4 (66.7 per cent)
Condition satisfactory	11 (50 per cent)	3 (60 per cent excluding one under treatment)
C.—*Slight Effusions*	16, all untreated (in 15 patients)	
Pneumothorax discontinued	1 (Terminal) (bronchopneumonia)	
Pleural space obliterated	1	
Pleural space unaffected	8	
Living	8 (53.3 per cent)	
Condition satisfactory	4	
Still under treatment	2	

This comparison of the consequences and results in cases where the exudate was let alone and those where it was interfered with (usually by aspiration and replacement) is seen not to be entirely a simple matter, but appears to indicate that (1) in the case of the larger exudates better results were obtained when they were not allowed to accumulate and organize, but that some formation of adhesions and resultant contraction of the pleural space is difficult to prevent by any measures; (2) in the case of the moderate effusions, only a small number of which were treated, there appeared to be little if any advantage in result over the untreated; this, however, may quite possibly be due to selection of the cases, the treated being those which showed most tendency to persist and least to resorb, or else those which presented the most marked symptoms. In about one-third of the untreated the pleural space became obliterated; (3) even slight effusions may have a definite effect on the pleural space, but it seems impossible to prevent this gradual contractile process.

Consequences and Mortality of Purulent Exudates:

All of these patients were extremely ill, although at the onset the effusion was serous in all but one case, in which case it may be remarked that no evidence was obtained of bronchial communication with the pleura. The two patients who showed evidence of bronchial communication evidently developed it at a period subsequent to the onset of symptoms—they suddenly found themselves unable to bring up the customary amount of sputum, and at the same time became rapidly quite ill with evidences of sepsis; in both cases the fact of bronchial communication was proved by the introduction of aniline dye substances into the pleural cavity and their reappearance in the sputum within a short time. Both these patients eventually died despite all treatment, including thoracotomy and drainage. Three other patients who had secondary infection with pyogenic organisms but no demonstrable bronchial communication were treated by repeated aspiration, pleural irrigation, and introduction of

gentian violet in dilution from 1-5,000 to 1-2,500, with fairly rapid disappearance of the pyogenic organisms from the exudate, but persistence of a tuberculous empyema, which in two cases eventually was resorbed, but in the other gave rise to such serious toxic symptoms that a thoracotomy was necessary and later on a thoracoplasty was also performed by the same surgeon; the eventual result is still in doubt. Of the four purely tuberculous empyemas, as mentioned, 2 are living and 2 dead; one only is reported in satisfactory condition; one of those who died succumbed shortly following a thoracoplasty, but had previously been running an unfavorable course following partial resorption of the exudate with pulling out of the cavities in the compressed lung. We have tried introduction of methylene blue solutions into the pleura following removal of the exudate by aspiration, but have not been particularly impressed by the results. We have also tried lavage with saline or weak sodium carbonate solution. In the cases of those who did badly, reactivation of the pulmonary disease following partial re-expansion of the previously collapsed lung appeared to be at least as important a factor as the empyema *per se*.

Consequences and Mortality of Associated Pyogenic Infection:

This was found present in eight cases (see laboratory data), and was associated with more or less severe and rapidly developing constitutional symptoms in all but one case. The effusions in 2 cases were clear when the organisms were first demonstrated, in 2 cases turbid and in 4 purulent in character. One case, with a clear fluid showing diplococci resembling pneumococci, terminated rapidly within a few days. In 5 cases intensive treatment by aspiration, lavage, and introduction of gentian violet solution, was carried out—until at least 2 successive negative cultures of the fluid were obtained, except in one case with bronchial communication, which terminated fatally despite surgical intervention. The fever and other toxic symptoms in at least two instances were rather promptly influenced, but in all tubercle bacilli were eventually demonstrated either on smear or animal inoculation, showing that a purely pyogenic infection of the pleura in a tuberculous subject is probably extremely rare and also accounting for the fact that as a rule the clinical symptoms do not clear up completely and rapidly, even with the disappearance of pyogenic organisms from the exudate. Of the two remaining patients, one was treated only by aspiration and replacement of air, because as mentioned, there were no prominent symptoms except those due to the mechanical pressure of the fluid; the other patient having bronchial communication died after about two months. This mortality of 37.5 per cent. and of only 1 among 5 promptly treated is, we think, unusually low for this type of case. Where there is patent bronchial communication the outlook is manifestly unfavorable, probably hopeless. It should be remarked that the effect of gentian violet seems to be exerted particularly on Gram-positive organisms.

LABORATORY FINDINGS

Thirty-seven fluids from thirty-six patients (approximately the last half of those reported above) received laboratory examination. In this routine the character of the fluid was noted (clear or purulent), the amount of albumen estimated (Esbach method) and tubercle bacilli were searched for both by direct smear and animal inoculation. In addition, stains (Gram's) were made for the presence (or absence) of other organisms, the cytology of the fluid noted and finally cultures made. For this it is necessary that the fluid be removed aseptically. For animal inoculation usually 10 cc. were injected intraperitoneally in the guinea pig. In arranging this study only the results of the primary or first examination are listed.

Tubercle Bacilli

The findings with regard to the presence or absence of these are reported in table 1.

Table 1

POSITIVES					NEGATIVES
Direct smear	Animal inoculation	Reinoculation	Total	Percentage	Total
1*	24	2	27	80%	7

From this high percentage of positive (80 per cent.) it is natural to assume that, had later specimens been obtained, may of these negatives would have been transferred to the positive group. The published reports of Paterson, Rist, Kendall and Alexander, Henius, Weiss, Saugman, Von Muralt and Begtrup-Hansen also show that tubercle bacilli are present in a large proportion of these fluids.

The inoculated animals usually exhibited a mild and slowly progressive tuberculosis. We believe this is due to the paucity of tubercle bacilli in these exudates rather than to any lowered virulence, as bacilli were demonstrated on direct smears only four times out of thirty-seven. This belief is substantiated by the experimental work of Paterson.[18]

Other Organisms

Twenty-seven cases were cultured, eight of which were positive. Staphylococcus (alone) occurred five times, staphylococcus with diplococcus once, diplococcus (alone) once, and pneumococcus iv. once, all gram positive. In addition, two cases showed gram positive diplococci

* This was a purulent fluid and failed to produce tuberculosis on inoculation.

on direct smears; one was not cultured and the other did not grow on culture. The former ended rapidly in a fatal termination and the latter had been given gentian violet instillations on the suspicion of infection.

Of the positive cultures, four were purulent at the time of culture and three became so shortly afterward. Only one was non-purulent and this may have been the result of accidental contamination. The gentian violet treated fluid never became frankly purulent.

Albumen

The albumen was estimated in twenty-nine of these cases and the amount ranged from 2—6 per cent. Seventeen were over and twelve under 3 per cent. with a general average of 3¼ per cent. Although the Esbach method is only approximately accurate, our average findings agree fairly closely with the more accurate estimation mentioned by Wells[19] and with the albumen content of simple tuberculous effusions as found by us. As for various reasons the specific gravity was estimated in only one-third of these fluids, this finding is not included in this report.

Cytology

The cytology of these fluids showed the mononuclears usually to predominate, although with an acute or "stormy" onset, or where secondary organisms were present, the polynuclears were often found in excess. The latter also applies to those cases where the pleural reaction is progressive and which, gradually showing more and more cells, finally become purulent without the presence of secondary organisms.

From the above evidence it will readily be seen that these effusions are of bacterial (tuberculous) origin and are inflammatory exudates and not transudates. The latter are non-inflammatory in origin, contain less than 2.5 per cent. of albumen and do not coagulate spontaneously. The tendency to coagulate on standing was commonly present in the fluids reported.

GENERAL DISCUSSION

When we come to consider the etiological factors of these effusions we should attempt to distinguish between (1) direct or immediate and (2) predisposing causes. Among the latter have been mentioned many things—for example, cold, rheumatism, long journeys, physical overexertion, etc. Von Muralt (cited by Riviere) has noted a special frequency in March and April, and Dumarest[16] has also observed a preference for the changing seasons, spring and autumn. We believe that some of these things do or may play a contributory rôle. For example, we had formed the impression that chilling of the body surface, which is more likely to occur during cold and windy, damp and chilly, or exceedingly changeable weather, than during the more uniform summer season, played a part in the provocation of effusion; and our statistics as to seasonal incidence lend some support to this; nevertheless we have thus

far been unable in a tuberculous rabbit subjected to artificial pneumothorax for some weeks and then exposed to chilling (by ether spray or by a fan playing on the moist surface) to induce the appearance of any effusion. However, within eight or ten days after intrapleural injection of bovine bacilli, an effusion appeared. Some have assumed, it appears to us on quite inadequate grounds, that the introduction of nitrogen gas, or as Bullock and Twichell[20] specify, cold nitrogen gas, into the pleural space, excites effusion, either by direct irritation, or by causing alterations in the pleura which interfere with the mechanism of secretion and absorption. The character of these effusions, which as has been shown, are probably always exudates, and tuberculous exudates into the bargain, should dispose of any fine-spun circulatory theory of their formation, including the theory of retarded resorption of normal secretion.

Rist[8] has pointed out that the irritating effects of nitrogen gas can scarcely be held responsible, since this complication is never met with in experimental pneumothorax. There has been no convincing evidence presented to show that warming the air or gas has prevented effusion. Moreover, the specific heat of nitrogen is low and it rapidly assumes the temperature of the surrounding medium.

We also find occasional authors here and there stressing some particular refinement of technic or asepsis necessary to prevent pleural infection from without; but the most careful operators still encounter effusions in abundance; few show pyogenic organisms, but the tubercle bacillus we have practically always with us. Moreover the serous membranes are probably more resistant to the chance introduction of an occasional staphylococcus from the skin than was formerly thought. In fact, as to the direct or immediate cause of these effusions, or at least of the vast majority, he who carefully investigates the evidence available can be in little doubt.

Forlanini[1] regarded the etiology as probably the same as that of the ordinary pleurisy accompanying phthisis, that is, in most cases due to the migration of pathogenic organisms from lung to pleura, but as it occurs more frequently than the ordinary pleurisy with effusion, thinks that other causative factors must also operate. These factors are obviously in the main mechanical ones. Brauer and Spengler[4] mention retrograde infection of the pleura from the diseased lung, but appear to think that it usually follows puncture of the lung by the needle or trocar. Weiss[3] regards these exudates as practically all due to infection—presumably he means with tubercle bacilli, as he states that their presence can nearly always be demonstrated. As we have mentioned, this has been corroborated by other careful observers, where animal inoculation has been used. That the tearing of an adhesion may operate as an occasional cause and source of such infection seems unquestionable, but we do not believe it to be a necessary one, since we frequently see adhesions separate without effusion occurring, and also see effusions occur where there has been a practically complete pneumothorax for some time,

with no change in the pressure under which the air or gas is administered. We are not greatly impressed with the importance of a high or low pressure *per se* in causing exudates, except where there are thin-walled cavities near the surface, with attached bands of adhesions, in which case the accident to be expected is a sudden spontaneous pneumothorax or pyo-pneumothorax and not simple serous effusion. The whole controversy as to whether a high or low intrapleural pressure is more conducive to exudate seems to us rather far-fetched and unprofitable, and no constant or even frequent correlation has been observed at Loomis.

Attention has been called by a number of authors to the undoubted fact that extension of a tuberculous deposit in or near the pleura is probably easier when the pleural surfaces are separated, as localizing adhesions cannot form. This conception of an endogenous reinfection of, or migration of bacilli to the pleura, is in accordance with the observed facts. The occasional presence of other organisms besides tubercle bacilli is not surprising, since they are frequently found in advanced ulcerating tuberculous lesions of the lung. The greater frequency of exudates which we have observed during the earlier months of treatment would also be expected, as the lymph-channels are then probably more permeable and cluttered up with organisms and fibrotic encapsulation has not yet had a chance to take place. Moreover, unwonted exertion undertaken too soon might readily increase the movement of lymph and dislodge bacilli into channels leading to the periphery. In this connection a brief review of the lymph flow in the normal and pathological lung is quite apropos. This matter has been most painstakingly gone into by W. S. Miller [24] who has shown that the valves in the communicating vessels between the pleural and the deeper pulmonary lymphatics always point toward the pleura, and that while drainage from the lung under normal conditions is toward the hilum, if this is prevented, it is into the pleural vessels.

The important experimental work of Paterson [18] on the pleural reaction to inoculation with tubercle bacilli in normal and in vaccinated guinea-pigs, following a similar piece of work by Floyd [22] with other organisms, shows that (1) intrapleural inoculation of tubercle bacilli in tuberculous guinea-pigs results in exudation of serum, leucocytes, red blood cells, and fibrin; in a normal guinea-pig there is no noticeable pleural reaction but a rapid dissemination of infection; (2) the effusions are capable of causing tuberculosis in guinea-pigs although no bacilli can be found (on staining). He also concludes that clinical pleural effusions in tuberculosis are caused by the infection of an allergic pleura. Elsewhere[13] he considered the effusions occurring in artificial pneumothorax as probably of the same origin, the re-infection occurring either by the tearing of adhesions or altered lymph flow.

There has been some diversity of opinion as to the effects and consequences of these effusions on the course and outcome of the case. Com-

parative statistics, as we have pointed out, are not entirely reliable, chiefly on account of the great diversity of conditions which must be grouped together, and the entrance of other variable or unknown factors. Saugman[6] in a considerable series has noted a slight advantage in the end results in the "dry cases." Sachs[11] says that while in a certain percentage of cases improvement does occur, this complication is regarded by most experienced observers as affecting the future outlook (unfavorably). Occasional symptomatic improvement, often only temporary, has been noted by many, either shortly after their appearance, when it is most generally ascribed to improved lung collapse, or following resorption, when other mechanical factors, such as the stiffening of a flexible and swaying mediastinum, come into play. LeRoy S. Peters[14] regards the effects, at least of simple serous effusions, as mainly mechanical. Shortle[12] says that except in the case of purulent exudates it is the consensus of opinion that if properly treated little harm results unless adhesions form and the pleural cavity becomes largely abolished. Both the "if" and "unless," we should add, require emphasis.

Riviere[9] has divided the effects of pleurisy in pneumothorax into (1) beneficial and (2) unfavorable, and thinks it difficult to generalize. He believes the beneficial results are mainly mechanical, despite the reported demonstration of specific antibodies in many cases, and is not convinced that they are lasting. Among the unfavorable effects is the serious deterioration of the general condition which usually ensues when fever and constitutional symptoms are protracted; the obvious pressure symptoms, with occasional dislocation of organs; also the thickening of the visceral pleura which interferes with later expansion of the lung. (In certain cases this might be a desirable thing). The formation of dense adhesions following resorption of the exudate, preventing or limiting the continuance of treatment and gradually tending to draw the lung out and often to reopen old lesions, has been noted so often that it is an old story and often a disheartening last chapter. As Weiss has observed, the compressed lung behind the exudate frequently begins to expand before undesirable symptoms make their appearance. The manner of absorption and organization of the exudate appears to be such that watchful waiting and most careful fluoroscopy often fail to detect it until it is too late. Hence the practice has grown in favor of late of removing considerable or persistent accumulations and replacing them with gas. What particular gas is used seems rather immaterial. Atmospheric air is most convenient. Morriston Davies[23] and the English writers generally seem to favor oxygen to replace fluid, but for just what reason we are unable to ascertain. Recently we have tried carbon dioxide gas in a few instances because of the work of Corper, Gauss, and Rensch[24] which appeared to show that tubercle bacilli are inhibited or killed by high concentration of this gas.

Finally, while it may not be a consequence of the effusion, Riviere and others have at times noted to be associated with it or follow it a spread of disease not only in the homolateral but also in the contralateral lung.

SUMMARY AND CONCLUSIONS

Over 50 per cent. of our patients treated by artificial pneumothorax have developed recognizable pleural effusions, and several have developed repeated effusions. They are most frequent in the earlier months of treatment, but may occur even after a long-continued successful compression, and even after the lung has been allowed to re-expand.

The seasonal order of frequency from our records appears to be (1) autumn (2) winter (3) spring (4) summer.

Twelve per cent. of our effusions have later assumed the purulent character of tuberculous empyemas. Occasionally infection with pyogenic organisms occurs, sometimes apparently preceding but always in association with tuberculous empyema. In very few of these cases have we been able to demonstrate bronchial communication. Where the appearance of a pleural effusion is associated with pronounced constitutional symptoms, a specimen of the fluid should always be removed and smears and cultures made and examined without delay.

In about one-third of our cases pneumothorax was discontinued because of the effusion, or the obliteration of the pleural space followed its organization and absorption, while in nearly one-half the pleural space became more or less contracted afterward.

Tubercle bacilli can be found on direct smear in a small proportion of cases but are demonstrable on guinea-pig inoculation in the vast majority (80 per cent. in our series). The more carefully it is sought for the more frequently will evidence of their presence be found.

The appearance of these effusions signifies an allergic response on the part of the pleura to endogenous infection, probably usually from intrapulmonary foci by lymphatic metastasis. It is simply, as Krause[25] puts it, a "phase of reinfection in the sense that it represents extension or metastasis from foci elsewhere in the body." The allergic serous membrane (pleura) responds characteristically with the formation of an exudate. The extent and kind of the pleural reaction is probably in proportion to the degree of infection.

Empyema except where rupture has occurred is merely the final step in the progress of a pleural effusion where the pleural reaction is progressive.

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DISCUSSION ON ARTIFICIAL PNEUMOTHORAX

Dr. LeRoy S. Peters, Albuquerque, N. M.: When Dr. Ringer sent me his paper to look over, I was impressed with the fact that when any man has given pneumothorax treatment over a period of years, we all come to about the same conclusions, and that there is little in the way of argument on any given paper.

I wish Dr. Ringer could have given you his paper in its entirety because he touched upon practically all the points that should be covered in a paper on artificial pneumothorax. The more I give lung compression, the more I am convinced, that it should not be used as a last resort measure, but the less anxious I am to compress the early type case. I feel, that because of the certain complications that exist in all cases sooner or later, or at least in the large majority of them, we are not given the right to compress early tuberculosis. On the other hand, I do not believe we should use it as a palliative measure to relieve the last days of a dying consumptive, because when we do that, we only add to our death list, and then when suitable type cases for compression come, they are deterred many times by the sad experiences of the case in which we gave it as a palliative measure.

I want to speak a minute on the question of its use in hemorrhage I do not believe that it should be used, except as a possible means of saving life in the case of a very severe hemorrhage, until after the bleeding has stopped; in other words, if you have a hemorrhage case, it is much safer to produce your compression in the interval between bleeding, than it is to produce it at the time of the hemorrhage. I had always produced it at the time of the hemorrhage, until I had two sad catastrophies. One patient in whom I could not produce a complete compression died from drowning, a hemorrhage occurring during attempted compression of a partially adherent lung. The other patient died from

pneumonia. I believe in the majority of cases, you can wait until the hemorrhage is over, and then produce a compression much more safely.

I cannot conceive of as low an amount of air as 100 cc. to stop bleeding. If you are going to do that, give large doses and produce as complete a compression as possible. I think the reason Dr. Fine's patient stopped bleeding, was for the same reason that every other patient stops bleeding, not because of some specific treatment, but because the hemorrhage was over.

As to the question of pressure, I believe the majority of cases should be kept only on a neutral pressure; only after the patient has had treatment for a long period of time do I give anything in the way of a positive pressure, and then, as Dr. Ringer has said, only a plus 3 or 4. I had one patient in whom it was absolutely necessary to keep a negative pressure of minus 3 or 4, because of the elasticity of the mediastinum. That patient did very well with a partial compression. I could not give complete compression because of the pushing over of the mediastinum.

I do not believe that any one complication is more annoying than that of fluid formation. It occurs in a large percentage of patients, and in many cases, pus develops, which gives us a bad prognosis.

I am not as pessimistic as Dr. Ringer on the end results by compression. Here you are taking an unfavorable type of consumptive, and if you are getting 16 per cent. arrests, you have really increased that unfavorable patient's chance 16 per cent., because the uncompressed, unfavorable type fights a losing battle.

Dr. Ethan A. Gray, Chicago: I am very glad Dr. Ringer has emphasized one point, that is, the objections to the doctrine that it is proper to try to tear adhesions. I never thought that people would do such a thing until I was speaking with one or two men here and they said they thought they would be able to do it. I said I was afraid I had done it.

Again, as to the obliteration of the pneumothorax cavity.

What is the end result of your pneumothorax; what are you trying to do; what happens to the lung? If the lung be closed down by a plastic exudate, sooner or later the lung must approximate the chest wall, sooner or later the chest wall must collapse and the mediastinum come over, and there will be an absolute obliteration, if you wait long enough, of your pneumothorax. That, I think, is a consummation devoutly to be wished and I see nothing wrong with it.

I also believe it is a good thing to use a pneumothorax to give any man a chance of living one year, two years, three years or four years.

As to the matter of difficulty in diagnosing hemorrhage, in order that we may be sure that we shall collapse the proper lung; if we have a mobile mediastinum, it might not make much difference to us whether we collapse one lung or the other, if it be true, as has been stated here today, that the intrathoracic compression on one side will sufficiently increase the pressure on the other side; but I prefer to collapse the bleeding

lung, not the other; nor have I ever yet put the needle into the chest over which I heard the bubbling, loud râles.

Where there are no sounds, in the presence of a massive hemorrhage, I feel that that is where I should try to exert my pressure, the idea being that the massive hemorrhage fills the bronchial tree and floods over into the sound lung, producing these loud, bubbling râles, which might mislead the casual observer.

Dr. Nathan Barlow, U.S.P.H.S.: One of the gentlemen said that a partial pneumothorax should be maintained indefinitely in certain cases. You cannot maintain any kind of a pneumothorax indefinitely except in very rare cases. The usual life of your complete pneumothorax is two years; the usual life of your partial pneumothorax is likely to be shorter than this, and just in proportion as you make your pneumothorax complete, you have to watch your adhesions.

Another point about the causation of the fluid; we have found in our studies that one of the most frequent causes of the fluid is the rupture of adhesion owing to the irregular amounts of collapse which you produce in your ordinary method of pneumothorax; you are swinging the pleura back and forth and you get adhesion and you put in a great amount of air and rupture the adhesion. In our work of partial pneumothorax, as long as we keep an even degree of compression, fluid is almost unknown; you can carry a case for months, and a number of cases for months. without any fluid at all.

There was one other point which, particularly in your cases when you begin to use more or less partial pneumothorax, needs to be observed. When you have placed enough air into a pleural cavity, partially or wholly around the lungs, you reduce the toxemia and it is impossible to get any physical signs of activity, and you consider the patient as quiescent and let him get up and walk around; and the patient had a far advanced lesion when you started the pneumothorax. No man can get the healing of a far advanced lesion in a few weeks or months, and yet because you have given him a pneumothorax you let him walk around and attend to business. You are not going to get any permanent results, when you apply pneumothorax, unless you consider it merely as an aid in the treatment of the tuberculosis and treat the tuberculosis just the same as if you hadn't put the pneumothorax in his chest.

Dr. J. W. Coon, Stevens Point, Wis.: I wish to report one case of pneumothorax, simply for the reason that it is an unusual one because of the length of time the treatment has been kept up. The case in point has had a complete collapse of the left lung now for more than eight years; perhaps one of the longest cases on record. It was a case that was begun by the late Dr. Theodore B. Sachs for hemorrhage and was continued by him until the time of his death, after which I took charge of the case. It has been a complete collapse during most of this time and for four and one-half years has been kept up at the earnest request

of the patient, probably more for its cosmetic effect, and the feeling of comfort that it gives, rather than any real need of it. The patient is in perfect health, is working constantly, is up to normal in weight, has had for nearly five years no symptoms at all, but insists on the collapse of the lung being kept up. I have been giving her from 850 to 900 cc. about once in four or five weeks, keeping up a positive pressure, that is, giving until a positive pressure of about 6 cm. H_2O is reached.

Dr. Charles M. Montgomery, Oteen, N. C.: I would like to ask Dr. Stivelman one question on the subject alluded to. It brings up a fundamental point and, if it is established, I want to be set right on it. Otherwise it seems worth while to report on it at this time: namely, the subject of equal pressure in the two pleural cavities, one of which is the seat of the pneumothorax where the mediastinum is normal. The occurrence of this equal pressure was claimed by Graham and Bell about 1919. Given a positive pressure on both expiration and inspiration on the pneumothorax side, the mediastinum being normal, is it possible on the other side, not the seat of pneumothorax, to likewise have positive pressure, both during inspiration and expiration? Would not such positive pressure lead to complete collapse of the lung, with fatal results?

Dr. Alexander Armstrong, White Haven, Pa.: I think this is one of the most instructive seances on the subject of artificial pneumothorax to which I have ever listened. Almost every phase has been covered in the discussion. However, in regard to Dr. Fine's paper on hemoptysis, I want to emphasize one point he made. When you start compression of the lung, you should continue the treatment. After hemoptysis the patient is eager for the treatment and it is then wise to continue. I mention this because so often the physician gives the compression and then stops and waits apparently for another hemorrhage before continuing it. I think that case should be kept under compression indefinitely.

There has been a good deal said at this meeting about partial compressions and I think most of you who have been doing this work as long as Dr. Ringer and I have been doing it, will agree that we have practically been doing that. It was brought out apparently at this meeting as a new idea. With due regard to the gentleman who brought it out, I feel that we have been doing, all of us, to a certain extent, partial compression. None of us feel like putting in 1,000 cc., as we did nine years ago, at the first sitting. I think it should be more gradual; but I think after we get an apparent arrest and apparent well-being of the patient and a condition which is going toward a definite arrest or cure, we gradually withdraw our gas at regular intervals. That practically acts the same as a partial collapse.

Dr. John Ritter, Chicago: I believe views differ greatly as to pulmonary hemorrhage. The first essayist spoke about a teaspoonful, a drachm of blood; this may come from anywhere, from the mouth, the

teeth, from nasopharynx, etc., and not necessarily from the lungs. A single teaspoonful of expectorated blood does not constitute a pulmonary hemorrhage and we have no assurance that such an amount of blood really came from the lungs. I do not believe that any one is justified in compressing a lung, doing a pneumothorax, on the strength of seeing a drachm of blood expectorated on but one occasion. Usually a teaspoonful of blood from the mouth is not considered a pulmonary hemorrhage and regarding compression in such an instance, would 200 cc. be sufficient to immobilize the lung? Has not the psychological effect here something to do when 200 cc. are reported to suffice to inhibit the bleeding?

Dr. Fine: First I would like to answer the question in regard to the teaspoonful of hemorrhage I mentioned. When I mentioned "teaspoonful of blood," I said the hemorrhage started with a teaspoonful of blood and later became more severe; then I gave an artificial pneumothorax.

In regard to Dr. Peters' remark that it would be better to wait until the patient's hemorrhage stops and then give him an artificial pneumothorax, I brought this point to you only in view of the fact of giving pneumothorax in hemorrhage. I cited only cases where I had to give the artificial pneumothorax once or twice to prepare the patient to go to sanatoria where treatment was continued.

The cases which came under my observation were only placed in the hospital for emergency and if the hemmorhage continues the patient can't be sent to the sanatorium. We usually try all the medications we know of, for the stopping of the hemorrhage; if these methods fail then we resort to pneumothorax.

In regard to the necessary amount of air, I find, from the cases where I have given pneumothorax, that 300 cc. is just sufficient to stop the bleeding, even in a severe hemorrhage. I cited one case where the man had a severe hemorrhage and the bleeding stopped immediately.

One gentleman spoke about the gurgling sound on the opposite side. I found that the gurgling sounds are always heard on the side where the hemorrhage occurs, unless the hemorrhage is severe, then the gurgling sound is distributed throughout the chest but heard more distinctly on the side where the hemorrhage occurs. In such cases the patient invariably dies of drowning in his own blood.

Dr. Stivelman: The subject of negative pressures in pneumothorax work has recently been very well discussed in the paper by Drs. Barlow and Kramer. Most of us have really used negative pressures for many years, but I think that we ought to commend the authors for the way in which they have crystallized our thoughts for us. I believe that negative pressures continued for some time will give much better results than the indiscriminate use of positive pressures.

Dr. Ringer's statement in respect to the few successful cases at the Montefiore Home requires explanation. In our city institution the cases

are as a rule so far advanced and so desperate that the results obtained in institutions where this method of therapy is applied to more favorable cases, can never be hoped to be attained. At the Montefiore Sanatorium at Bedford Hills, we have patients whose condition is much better than those at the Montefiore Hospital, and the results obtained rival those of many workers in the field. Some months ago we were able to describe 78 cases, 57 per cent. of which improved under this method of therapy and about 30 per cent. of these were discharged with disease arrested.

Dr. Gray has spoken about the obliteration of the pleural cavity. Obliteration of the pleural cavity renders the patient's prognosis very grave if you let it go on. Shrinkage of the pleura instead of pulling the chest cavity in, pulls the lung out, opening up cavities permitting hemoptysis, and there is invariably a recrudescence of the disease. Sepsis soon sets in and the patient is gone. This obliteration can be prevented or at least very much delayed by the gradual induction of high intrapleural tension through the medium of pneumothorax. We have carried patients with beginning obliteration of the pleural cavity for from three to five years and they are with us today, and many of them are working and come back for refills at definite intervals. In these cases we go up as high as 60-70 millometers of mercury. We have had no cases of rupture, but I must emphasize that we have been careful to resort to such high pressures only in cases where there was an obliteration of the pleural cavity, *en masse,* and where there were no demonstrable, cord-like adhesions.

So far as collapse in hemoptysis is concerned I do not think that we ought to wait until there is a definite clot in the bleeding vessel before inducing pneumothorax. When the clot is formed and bleeding stops it is high time to keep our hands off. I think the time to induce pneumothorax is when the bleeding goes on and cannot be stopped otherwise.

The work of Grahm and Bell, Betchow and Simon which was done on rabbits, guinea-pigs, sheep and humans, and our own work at the Montefiore Sanatorium has proven conclusively that in pneumothorax there is no difference in the pressure on either side when the mediastinum is labile and flexible. In other words, given a case that has a minus 2, minus 4 pressure on either side, and we inject gas, say on the right side, and the pressure is reduced 2 points, there will be a similar reduction of 2 points on the untreated left side. When we reach a positive pressure on one side the positive pressure is at once transmitted to the other side. However, this positive pressure on the untreated side is overcome by the excessory muscles of respiration and greater effort of the diaphragm, so that a negative pressure is induced sufficient to maintain respiratory function.

As it has been shown, it is sometimes advantageous to have a slight positive pressure on the untreated, less diseased lung. This compression causes a diminution in the residual air of the untreated lung so that each respiratory act causes a more thorough oxygenation than would

have been possible otherwise, in other words, the compression of the untreated lung and the moderate atelestasis thus produced therein is compensated for by the more thorough ventilation of this organ as a result of decrease in the amount of residual air in the dead space.

Dr. Ringer: I must congratulate Dr. Stivelman upon his results of 57 per cent. recovery in his work. They have so far surpassed mine and any others whose work I have heard of that I am astounded at the figures. They tend to make one more hopeful for the future. The morning I left Asheville for Washington there came into my office a man to whom I had last given pneumothorax in 1915. He was in perfect health and had had no injection since that time. As I did not want to go all over the figures and correct my percentages in my paper, I reserved him for my closing remarks, so I really have one more case of perfect recovery, which makes me only 44 per cent. behind Dr. Stivelman.

Of course we are all using partial compression and will continue to do so as long as pneumothorax is used. We have as a matter of fact very few one hundred per cent. complete compressions. I cannot agree with Dr. Barlow as to his statement of the duration of total collapse; of the consequent less duration of partial collapse. It is perfectly true, as several of us have stated, that unfortunately in the course of a pneumothorax, one or another of the accidents incident to its administration often force discontinuance of the procedure. None the less, if no complication sets in there is no reason why a complete compression should not be maintained for four, five, or six years. I myself have maintained two partial compressions for between two and three years and if the case is watched carefully, if the tendency of the pleural cavity to obliterate and of the mediastinum to shift over toward the treated side is forestalled and combatted, I can see no reason why there should be any arbitrary limit set to either total compression on one hand or to partial compression on the other.

What is the great final disideratum in pneumothorax? It is complete re-expansion. Just as what we wish at first is complete compression, so after sufficient period of time has elapsed for us to believe that the lung has healed from apex to base, then do we wish complete re-expansion. I have seen several cases where the lung has re-expanded and where so excellent was the result that it was next to impossible to tell which side had been compressed.

A PRELIMINARY NOTE UPON THE USE OF PARAFFIN OIL IN THE PLEURA AS A MEANS OF LUNG COMPRESSION

Experimental Work

By Edward Archibald, M.D.

Montreal

This report is merely a preliminary note. The idea is that artificial pneumothorax as produced in the ordinary way has its disadvantages. You have first of all the frequent re-fills which to some patients are a great disadvantage, although to some they are not. In the second place, you have the danger of losing gas rather easily, as has been emphasized in our symposium on pneumothorax.

It occurred to me that if one could put into the pleura a non-absorbable substance which would stay there, we would get rid of the re-fills and also get rid of the danger of the recurrence of adhesions and the loss of the pneumothorax.

Now, briefly, I have put paraffin oil, which occurred to me as the most natural thing likely to be non-absorbable, into the pleura of twelve cats and one dog. In all but one of the twelve cats the paraffin oil was absorbed comparatively rapidly. That was the first surprise. The result was disappointing in the sense that the oil was not non-absorbable, but absorbable. I put anywhere from 40 cc. into the right pleura of the cat, up to 160 cc. When the amount was over 50 or 60 cc. it invariably went into the left pleura. That is a detail. But of these amounts one might say that roughly half would be absorbed in anywhere from two to three weeks, or three to four weeks. You would find small amounts of it after a month and a half, and even two months. There was one exception to that and that was in the case of albolene, liquid albolene, which I happened to try in the middle of the experiments. These experiments have been carried on since last November, nearly six months. Liquid albolene remained with very little absorption in the pleura for two months.

That was the one ray of light, and I have to leave it at that point. The conclusion therefore is that ordinary paraffiin oil, (as a matter of fact, I used Nujol for part of the cases and ordinary paraffin oil as delivered by the chemists in other cases) which is frequently non-absorbable is also absorbable. Liquid albolene in one case was apparently non-absorbable.

I thought if I put paraffin oil in the pleura, an x-ray would be perfectly easily taken. I found that the paraffin oil was perfectly pervious to the

rays and you got no shadow whatever. In a good many cases where the experiments were conducted with barium, silver salt and sodium bromide mixed with the paraffin oil in various percentages, the sodium bromide killed the cats through poisoning; the others did not.

I will show one slide showing the paraffin oil mixed with the silver salt, collene, just to show that one side does show on the screen.

(*Slide was shown*).

These chemicals, however, created adhesions to a considerable extent, and for that reason are unsuitable.

There is one other disability, which is that if you do put in paraffin oil, you cannot take pressures. So that on the whole there are disadvantages connected with it as well as possible advantages.

DISCUSSION ON PAPER BY DR. ARCHIBALD

Dr. A. H. W. Caulfeild, Toronto: Dr. Archibald has mentioned that no doubt a number of us have thought about the possible use of paraffin. In 1919-20 I carried out a few experiments with this oil regarding its possible role in compression of the lung. In the first place, I was surprised to find that paraffin oil was absorbed so quickly; working with rabbits and using 10, 20, 30 and 40 cc. amounts of oil I found that in every instance the oil was completely absorbed in fifteen days. Another feature which rather surprised me, in view of what the surgeons have said, is that the oil is absorbed without leaving any adhesions whatsoever.

As paraffin oil does not show by x-ray examinations the degree of compression was ascertained by mixing the oil with bismuth. The amount of compression with 30 cc. in a rabbit was very marked.

Dr. C. D. Parfitt, Gravenhurst, Ont.: Between 1905 and 1910, when pneumothorax was then in the ascendant, a good deal of work on the injection of paraffin oils into the pleural cavity was done by continental investigators. It was generally abandoned because of its tendency to cause adhesions through inflaming the pleura. I understand surgeons have used it in the peritoneal cavity and have abandoned it on account of the tendency to produce adhesions.

Dr. Archibald: I am glad to have this opportunity, which I neglected while talking, of saying that Dr. Caulfeild of Toronto, (as I found out when I came down here and had a talk with him) had already done this work and had abandoned it as long ago as 1919.

What Dr. Parfitt said is entirely new to me, I had gone over the literature for the last eight or nine years without finding any reference to it, and I am glad to know that the continental people have worked with it. On the other hand, I would say, so far as my work is concerned, that the adhesions of which he speaks were not caused at all if one used

pure paraffin oil. Nujol is what I used, and albolene. There were no adhesions; the compressions were quite good; microscopical compressions of the lungs would show very clearly. The pleura is always slightly thickened, but very slightly so, and I do not think that adhesion should cause the abandonment of the idea.

EXTRAPLEURAL THORACOPLASTY IN THE TREATMENT OF PULMONARY TUBERCULOSIS*

With Report On Four Cases

By C. D. Parfitt, M.D.

Gravenhurst, Ontario.

Nearly ten years' experience with artificial pneumothorax in the treatment of phthisis has confirmed my early enthusiasm for this method. Most physicians who have seriously applied it will, I think, agree that, with limitations, it is the most effective form of treatment that is at our disposal for the progressive case of any stage, and for indolent moderately advanced cases. Since it must be judged from its palliative as well as curative results, it may fairly be considered as the most beneficent measure, apart from sanatorium treatment, yet devised for the consumptive.

The degree of the pneumothorax materially influences the result. Saugman [1] in nearly 500 cases found that if collapse were complete 70 per cent. of patients were fit for work from 3 to 13 years after discharge; if limited by adhesions, 30 per cent.; if limited by extensive adhesions, 11 per cent. The cases combined show that 32 per cent. are fit for work after 7 years; if no pneumothorax is possible, 16 per cent. He claims for pneumothorax that no other treatment gives the third-stage sputum-positive cases a 33 per cent. chance of being able to work after 7 years.

No patient for whom this form of treatment is indicated should be denied trial of it because of fear of failure, since occasionally an unexpected successful compression may be obtained. When failure results there is disappointment to both patient and physician. This was the case in 44 per cent. of our cases. Today a further chance is given a fair proportion of such patients by the so-called extrapleural thoracoplasty, now well established in Switzerland, Germany and Scandinavian countries, and to a limited extent in England and America. Dr. E. W. Archibald [2] has given papers before this Association on different phases of the subject in 1914, 1920 and 1921. Combined with careful and prolonged sanatorium supervision, this operation by a surgeon specialized in the method is calculated to convert a considerable number of hopeless into hopeful cases. Saugman estimates 6 per cent. of cases as suitable. It

*This paper with illustrations will appear in The American Review of Tuberculosis.

seems logical, and due the patients, to give this chance to a rigidly selected number of pneumothorax failures. In an editorial on the subject in 1920, the London *Lancet* caustically comments that it is "amazing that there should still be so long a 'latent period' between the origin of certain scientific discoveries and their general recognition." Occasional articles show that on this continent the value of this surgical procedure is becoming recognised.

The heavy mortality, at first about 25 per cent., of the extensive operation initiated by Brauer [3] and performed by Friedrich in 1907, discouraged interest. The less dramatic operation of paravertebral resection, devised by Sauerbruch, [4] is, however, much more encouraging. The several operative methods which have been devised more and more approach the Sauerbruch procedure. Morriston Davies, [5] however, urges as a supplementary operation at an early date, the resection of the rib cartilages (after Wilms), and claims that ultimate success may depend upon this.

Sauerbruch in 223 paravertebral resections had 1.3 per cent. early deaths from operation, while 11.6 per cent. more resulted fom complications arising from it. Despite this mortality of 13 per cent., he obtained 35 per cent. of practical cures in 391 cases subjected to various operations with the essential basic principles in view, viz.: the reduction in volume of the whole lung with the greatest practicable limitation of its functional activity.

Bull [6] in a series of 37 cases obtained a curative result in 45 per cent. (15 of 33 survivors). After adopting the two-stage operation only 4 per cent. died as an immediate result of operation.

Saugman [7] in 40 cases lost 4 (10 per cent.) from operation, 12 (30 per cent.) patients are under treatment (sanatorium), and 13 (33 per cent.) are able to work (6 light work). He emphasizes the necessity of prolonged sanatorium treatment before and after the operation as material to good results. So well is the success of the operation established that patients apply for the operation on their own account. Those operated upon call themselves "the hollowed."

Archibald has operated upon fifteen patients to date. Since adopting the Sauerbruch paravertebral resection quite early in the series, and in some cases supplementing this operation with his own modified anterior apicolysis, the mortality has been but slight and the results have been highly encouraging. Amongst these are the four cases here reported. The first two were reported by Dr. Archibald at the 1920 meeting, with details of the surgical methods employed.

Case 1 *No. 73—Mr. S. F. R.*

13/3/17: Age 26. At 21, phthisis, sputum positive, sanatorium treatment 14 months, fever to 101°, bed 3 months. No exercise for 4 years. Slight haemoptysis during 2 years. Gain in weight 39 lbs.

Present condition: Weight 145, 10 lbs. above usual weight before illness. Very pale. Sputum 2 oz. or more. Right lung, slight lesion above 2nd rib and 4th spine. Left lung, extensive fibroid lesion throughout, with great excavation and thickened pleura. Medium and moist râles throughout. Much retraction in front. Diminished expansion. Disease relatively quiescent.

Artificial pneumothorax attempted, interstitial emphysema twice, abandoned.

Referred for extrapleural thoracoplastic 4/12/17. Sputum 2-3 oz. Paravertebral resection, 10th—3rd rib, gas-oxygen and local anesthesia. Acute reaction for 6 weeks, beginning 5th day after operation. Temperature to 103° max. Marked fever for 8 days, slight haemoptysis, sputum increased to 8-10 ozs. for 3 weeks, reduced to 2 ozs. in 2 months. Recommended to return in 6 months for further operation on upper ribs.

Early summer 1918 patient felt better than at any time since onset of illness, he was relatively well and sputum had reduced to 2½ ozs. Midsummer 1918, an acute illness, sputum 4 ozs., marked albuminuria. Recovery, marriage. Return for operation delayed further by influenza epidemic. Influenza Jan. 1919. Feb. 1919, mucous colitis, slight diarrhoea and blood-streaked stools. X-ray examination was suggestive of a limited caecal tuberculosis.

Lost ground throughout 1919, increase of sputum to 2 ozs. Returned to Dr. Archibald for second operation 16/12/19. Gas-oxygen and local anesthesia. Anterior apicolysis with muscle plug, 2nd, 3rd, and 4th ribs resected. Prompt recovery from operation. 1/4/20, patient looks surprisingly well; has a good colour; coughs very seldom, usually after slight exertion. Expectoration greenish, about one-half oz. daily; sputum negative. No dyspnoea ordinarily; not very marked on slight exertion. No pain. Arm movements only slightly limited; can reach opposite shoulder and can feed himself. Chest measurements: expiration 33¼ inches, inspiration 33-⅞ inches. Right side, expiration 18 inches, inspiration 19 inches; left side, expiration 15½ inches, inspiration 15-⅞ inches. In the erect position the right side is enlarged and rounded; the movement apparently excessive; the movement of the left side almost nil. Under the left clavicle in the region of the resected ribs there is a marked depression and on inspiration a deep in-drawing. The right lung is hyper-resonant and shows complementary hypertrophy extending beyond the sternum. The breath sounds in the right interscapular region are variable in quality and the modifications are probably transmitted. Above the second rib there is slight vesiculobronchial breathing and a few crepitations. Over the left lung dulness is marked throughout. There are variable amphoric and bronchial breath sounds throughout. Râles of variable size are relatively few. (PLATE I, II.)

Good health continued until June, 1920, with 2-3 hours walking, some hours work, weight 145, sputum ½ oz. P. 64-78. Following a strenuous week severe autoinoculation. After rest for one month general health regained. In November 1920 severe exertion following house fire, autoinoculation, recovery. April 1922, more or less continuous light work. Bacilli absent two years. Very good condition and relative freedom from symptoms. (PLATE I. 4, a, b.)

This patient seemed an admirable case for thoracoplasty with an extraordinarily good right lung, but he was obliged to wait six months for the initial operation because of Dr. Archibald's absence during the war. Ill-

ness twice delayed the second operation, which was to have taken place in six months, to two years. Despite the one-time albuminuria and the questionable tuberculous colitis, the second operation was considered a justifiable risk in view of the very good right lung, and was well borne. The patient is enthusiastic about the result.

Case 2. *No. 226—Miss L. M. H.*

3/10/19: Age 23. Nurse in training. Family history negative.

Present illness: June 1917 German measles followed by slight cough; tonsillectomy July 1917, ether anesthesia, loss of 20 lbs. in weight; abscess of left upper lobe three weeks later. B. tuberculosis found September 1917. Life in health resorts for two years, no strict rest treatment. Patient always vigorous and has felt extremely well since Christmas 1917. Practically no rise in temperature except premenstrual and from mental excitement.

Present condition: Patient appears to be in excellent health; good colour; well nourished; never feels tired; 4 lbs. above usual weight; frequent cough; sputum 1 oz., positive; pulse range, 78-88; temperature range 97.8°-98.8°; haemoglobin 90 per cent. The right lung shows a lesion of moderate intensity above the second rib. The left lung shows an intense lesion throughout the greater part with widespread signs of excavation in the upper lobe and numerous moist râles. The x-ray plates confirm the physical findings. Above the 5th rib on the left side there appears to be a catacomb of cavities. (Plate II, 1.)

Course: Three weeks later (29/10/19), with little hope of success, artificial pneumothorax was attempted and a compression from a gas cavity of about 800 cc. capacity was obtained (Plate II, 2). A month later fluid formed (Plate II, 3). Referred for extrapleural thoracoplasty, with probable maintenance of pneumothorax. 19/2/20 first operation, an anterior apicolysis with partial excision of 2nd-4th ribs and the use of a muscle (pectoral) plug. 9/3/20 second operation, paravertebral resection, 3rd-7th ribs, inclusive. The lower ribs were left intact because of the fluid pressure in the pneumothorax cavity. Gas-oxygen and local anesthesia. The patient suffered considerably, especially following the second operation, and had moderate fever, fast pulse and pink sputum after each operation. She was out of bed on March 20th, and returned to the sanatorium a fortnight later.

11/4/20: The patient appears in excellent general condition. She stands erect and there is nothing noteworthy in posture. There is surprisingly good movement of the arm, with easy abduction to the level of the shoulder. The left side is distinctly smaller and is motionless on respiration. The left breast bulges more than the right because of the contraction of the left side. There is indrawing in the axilla and scapular region. There is no pain, but slight tenderness of the third interspace near the sternum. On auscultation, the left side shows feebleness of breath sounds above the third rib, with bronchovesicular quality, and almost complete absence below. No râles were heard. The right shows bronchovesicular breathing at the apex and in the interscapular region as low as the fifth spine, with fine râles. Cough is slight. Sputum is less than half an ounce, one third only of the amount before the operation, and is mucoid. Pulse 85 to 95. Temperature, maximum 98.8°. Haemoglobin 75 per cent. Weight 8 lbs. less than before operation. Dyspnoea is quite marked on slight exertion (Plate II, 4).

5/7/20: Sputum increasing; temperature 99.2°; increased râles in right upper lobe; probable excavation. (Plate II, 5). Two pneumothorax refills given since return. The lessening cavity was later filled with fluid which was not disturbed.

4/5/21: Patient looks less vigorous; weight 2 lbs. more than a year ago; pulse 72-82; temp. max. 98.8°; haemoglobin 80 per cent; sputum drachms 2-4. The right lung shows increased râles to the fifth rib in the axilla and to the scapular angle. Many râles in the left lung, some of which may be transmitted from the right. X-ray plates show large cavity laterally in the right upper lobe. (Plate II, 6). The right side expands ¾ inch, the left ¼ inch. (Plate II, 7, 8).

4/4/22: The general condition has improved. No rise in temperature. Weight 127 (a gain of six pounds in the last year). Physical signs unchanged. The patient has been living at home six months and enjoys a little liberty.

This patient was a questionable risk for thoracoplasty. The left lung had undergone much destruction, with little apparent influence upon the general health, and was very inefficient from the functional standpoint. The right lung was very doubtful and its invasion and destruction might possibly develop like the left. Nevertheless, for three months before the operation artificial pneumothorax had been apparently well borne. Sauerbruch considers the case with an existing partial pneumothorax a very suitable type for partial thoracoplasty with maintenance of the pneumothorax. Temperamental reasons also rather influenced the decision. The present status seems to have justified the decision in favor of thoracoplasty. The patient after early encouragement was, however, disappointed in the result. She expected much more than was possible. The remembrance of suffering from the operation itself then probably became magnified and she became somewhat sensitive about the scars and deformity. These disadvantages had been fully explained before she underwent the operation. Such points are important when the operation is considered for young women.

Case 3. *No. 191—Dr. W. W. H.*

30/3/19. Age 53, physician.

Family history: One brother died of phthisis, aet. 35; one sister also, aet. 40.

Previous history: Contact great in attendance upon relatives and during 14 years' practice amongst Indians. Onset of illness 9 years ago with haemoptysis. Early laryngeal involvement arrested. Treatment at high altitude resorts for two years, also with tuberculin for many months, with improvement, and with I-K. No special supervision. Irregular practice for seven years. Short period of sanatorium treatment in 1917. Futile attempt then at pneumothorax. Hard work during influenza epidemic, 1918, caused loss of 27 lbs. in weight, fever to 100°, and indigestion with vomiting.

Present condition: Patient is thin and looks tired; weight 115, 15 lbs. below usual weight and 23 lbs. below that of 1917; pulse 80-95; temperature

range 98° to 99.5°; cough frequent; sputum 3 ozs.; haemoglobin 80 per cent. The right lung shows signs of moderate infiltration to third rib and sixth spine. The left lung shows signs of extensive excavation to third rib and fourth spine and of less intense lesion throughout the remainder of the upper lobe. Below the scapula the lower lobe is hyperresonant, and there is widespread sibilus. Clinical findings confirmed by x-ray. (Plate III, 1).

4/6/19: Extrapleural thoracoplasty recommended and declined.

18/5/20: During the previous summer some general and local improvement. In the early autumn much nervousness and dyspepsia. Eyes corrected. X-ray showed adherent appendix, no tuberculous colitis. Dietetic treatment improved dyspepsia. In January, a third injection of old tuberculin, .000001 cc., caused reaction, general and focal, with probable increase of disease in the left lower lobe. Two months later, fever to 102°, bloody expectoration, sputum 4 ozs. Thoracoplasty now consented to (12/3/20). Patient then awaited subsidence of symptoms which now has taken place. Temp. 98°-99.4°; pulse 80-100; weight 121, net, six lbs. gain since admission. Lessened signs in left lower lobe.

5/8/20: Dr. Archibald removed 11½ inches from ribs 10-7 inclusive, 11/6/20, and approximately as much more from ribs 6-2 inclusive, 7/7/20. Acute symptoms due to fatigue from unwise travel prevailed at time of operation, pulse 118, temp. 101.8°. The patient bore the first operation well, the second less well, but was up in chair in eleven days and discharged 4/8/20, with pulse 88, temp. 98.8°. Returned to the sanatorium. Signs in the right lung approximately the same as in 1917 and in March 1919. Râles much less numerous in left lung. Sputum reduced from 4 ozs. to 1½ ozs. Pulse, 88-98; temp. 98°-99.6°; weight 113, a loss of 8 lbs.

25/4/21: Patient looks surprisingly well. Gain of 28 lbs. since return after operation. Pulse 75-90; temperature, normal range since Sept. 20th, with only a few days elevation above 99° in November; cough slight, sputum six drachms, last six specimens negative for B. t.; haemoglobin 100 per cent. Exercise, 20 minutes walking daily. Sleeps comfortably on left side, which for years had been impossible. No dyspepsia. The right side expands one inch on inspiration, the left one quarter inch. The area of scar below the scapular angle is markedly indrawn on inspiration. The heart's apex is 16 c. m. to left m. s. l. in the anterior axillary line; the trachea is drawn slightly to the left. The right lung extends slightly beyond the left sternal margin, the breath sounds are bronchial at the apex and occasional medium râles are heard above the second rib and fourth spine; bronchophony is increased over the right lung, probably due to transmission from the left side. The left side is flat on percussion, amphoric breath sounds and pectoriliquy of variable intensity throughout; a few medium and large moist râles are heard over the middle of the lung in front and behind. (Plate III, 2, 3, 4).

30/4/22: During the past year the patient has attended to his affairs, has engaged moderately in practice during the summer and autumn months, and has spent the winter at a health resort. By report he is in very good health.

The age of the patient was rather against operation, since it was feared that retraction of the cut ribs would be interfered with because of calcified cartilages. The chronicity of disease and limited stationary lesion in the right lung was believed to warrant the operation when first

suggested for relief of the large cavity and presumed mixed infection. Later it was urged in the hope that the further tuberculous involvement in the left lung might be controlled. Unfortunately a year was lost by delay, during which this further invasion took place.

Case 4. *No. 151—Mr. C. H. A.*

3/6/18: Age 33, commercial traveller, soldier 4 years.

Previous history. Pyorrhea, shell shock and trench fever; all since 1915. Cough four months, ischio-rectal abscess, temperature 103°. Sputum positive, night sweats, loss of 20 lbs. in weight.

Present condition: Patient frail, emaciated, very ill. Sputum 1 oz., pulse 90-102, temp. 101.8°, weight 112 lbs. Right lung: Infiltrative signs, relatively light to third rib and fourth spine; slight lesion near angle of scapula. Left lung: Signs of extensive consolidation with excavation above fourth rib, tympany below. X-ray plates show a very slight lesion in the second and third right interspaces and an extensive caseous condition in upper part of left lung, with a small spontaneous pneumothorax area in the axilla. (Plate IV, 1).

1/8/18: Artificial pneumothorax was induced 7/6/18. Fluid was seen in sulcus next day. Large partial pneumothorax ultimately established, a heavy adhesion preventing complete collapse. (Plate IV, 2). Temp. range now 97.2°-99°, pulse 80-90, weight 120, no cough, sputum once daily.

20/11/18: Marked general improvement, up since September 15th, transferred for treatment of pyorrhea. No râles now at right apex, some, probably transmitted, in right interscapular region.

31/12/19: Fluid, with consequent adhesions, have so reduced pneumothorax that it is now abandoned. Sputum two drachms, positive. Weight 130 (has lost 8 lbs. from max.). Exercise, 45 minutes for some months. Some intestinal indigestion. Barium meal negative for tuberculous colitis. (Plate IV, 3).

3/4/20: Discharged from sanatorium. Pulse, 70-90; temp., 97°-99°; weight 135. No increase of cough or sputum. Increased medium moist râles in left upper lobe. Immediate thoracoplasty advised.

22/6/20: Temp. to 100° max. for a month. Limited lesion high in right axilla, confirmed by x-ray. (Plate IV, 4). No increase of cough or sputum. Barium meal again negative.

11/9/20: Paravertebral resection, 10th-7th ribs inclusive, under gas-oxygen and local anesthesia, 20/7/20. Second operation, 2/8/20, resection of 6th-2nd ribs inclusive. Loss of ten pounds in weight, following operation, has regained seven pounds. Temperature fell from 100° to 99°. Sputum still about one-half ounce, but more mucoid.

3/5/21: Twenty-four teeth extracted for pyorrhea under gas and oxygen anesthesia, 23/11/20. Ten days later temperature dropped to normal. Sputum ceased at Christmas, with no recurrence until a "cold" ten days ago. Loss of weight of six pounds, following extractions, never regained. Exercise of 20 minutes twice daily for a month until "cold." Examination: Patient thin and worn (thinness characteristic of family). No obvious deformity. Left chest much contracted; no indrawing with inspiration. Total expansion, one inch; right, three-quarter inch, left, half inch. Right lung: Signs of infiltration above 2nd rib and 6th spine, relatively mild; pleuritic râles over

middle lobe and lower margin of lower lobe in axilla. Probable clinical activity. Left lung: Very flat throughout, except slight resonance at apex and base. Excursion of lower margin behind 2.5 c.m. Breath sounds bronchovesicular in front, amphoric in upper half behind, bronchial and bronchovesicular below. Medium moist râles scattered throughout. (Plate IV, 5, 6, 7).

27/2/22: Relapse during summer of 1921, beginning with April cold; probable intestinal tuberculosis in August. Dyspnoea increased. Further impairment of right lung, embarrassed heart's action. Urine normal in November; severe albuminuria in January. Death February 27th, 1922.

Thoracoplasty was rather a forced issue in this case in order to maintain the good done by pneumothorax to a very bad lung. Reactivation had begun. The lesion in the right upper lobe and the frail constitution of the patient both caused deep apprehension. The operation was justified for nine months and the patient was well pleased with the result, as five months after it had been done he was practically free from symptoms. The intestinal complication was in part responsible for the circulatory breakdown which caused death nineteen months after the operation.

The results obtained in the first and third cases have well justified this fairly severe operation. In the second and fourth cases its value may be questioned, but, considering all the circumstances, I believe the risk was warranted and that good resulted. There is undoubtedly a place for this measure in the treatment of tuberculosis, and it might be used oftener than it is. Apart from the recognized indications and contradictions, a nice judgment must be used as to the actual vitality and tenacity of life in the individual patient.

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DISCUSSION ON PAPER BY DR. PARFITT

Dr. Edward Archibald, Montreal: Dr. Parfitt suggested before the meeting that I should give a few figures as to the cases I have had. Briefly speaking, I have had fifteen cases of thoracoplasty, of which the first two died, (which I reported last year) one through a mistaken operation, a Friedrich operation, the other through an infection which I have never had since nor have I heard of it occurring with anybody else. Out of the thirteen other cases which may reasonably be considered,

one case died, (I also spoke about that last year) making a mortality of some 12 to 13 or 14 per cent. I forget the exact figures, but they correspond more or less with Sauerbruch's mortality.

The one other case about which Dr. Parfitt told you was a bad case from the beginning, a case of pneumonia; not a good type for operation; died twenty-four months after the operation of nephritis and intestinal tuberculosis, combined unquestionably with some process of pulmonary disease. He was relieved for a while. Of the twelve remaining, I count what Sauerbruch calls "practical cure" in three. That makes 25 per cent. By "practical cure" we mean practical abolition of sputum, at any rate to a couple of drams in twenty-four hours, loss of bronchial cough, no bacilli in the sputum,—if there is sputum—ability to work and general well-being. Under that definition, there are three who are "practical cures." Of these three, one, a doctor whom Dr. Parfitt has reported, is really a very, very remarkable result. There are 25 per cent. of marked improvements and 15 per cent. of slight improvements, making a total of about 40 per cent. improved. There were 25 per cent. that remained stationary, and among those stationary there were one or two whose disease was lighted up to a slight extent in the opposite lung, but nevertheless whose general condition was improved. In that kind of case there is a spread, a slight flare-up, but they overcome that and they are left with a diminished disease on the operated side and a slight increased disease on the good side, but their general ultimate result is, if anything, an improvement. They are classed, nevertheless, as stationary or not improved. That makes pretty well the total.

The results correspond fairly well (but it is still a little too soon to talk about them) with those of Sauerbruch to which Dr. Parfitt has referred. I would like to emphasize the meaning of the figures which he has given you. All of these cases are bad cases; some of them very bad. If you can get out of these bad cases 25 to 35 per cent. restored to activity, to some work, with abolition of cough and sputum, you are doing pretty nearly as well as you can with artificial pneumothorax. In other words, if you feel that artificial pneumothorax is worth while, then you must feel that thoracoplasty is worth while; and I feel, myself, that it is fair to say that if a patient, once considered for pneumothorax, is found not to admit air into the thorax, then at that moment the question of thoracoplasty should be seriously considered, and in the majority of instances advised.

As to the danger of the operation I will only say this: Having done the posterior operation on these fourteen cases, including the first one where I did the Friedrich operation, I feel that the posterior operation can be done safely; I mean that I have not had any trouble from the operation itself, they pull through nicely. The anterior operation for apicolysis, which I described a year or two ago, is a different affair altogether. I have done five of those, designed as a complement to the posterior operation, after waiting some months, or sometimes not after

waiting, to compress cavities which are left insufficiently compressed by the posterior operation. That operation, I think, is distinctly more dangerous. One patient died on the sixth day after that operation, (the one I referred to last year) but three others have survived it nicely and done well. However, in regard to my last one, which I did some two weeks ago, I have a telegram this morning saying, that the patient is not well and that he is in a dangerous condition. That makes one death and two scares out of five cases. Consequently, I am hesitating now to go on to the anterior operation without any very good cause, but the posterior operation does the bulk of the good work and I think should be advised without hesitation, provided you have somebody who can do it properly.

I would like to close by saying this: I think it is the duty of every member of this Association to be familiar with these figures because we are away behind Europe in this matter and because we are allowing patients to die, I should calculate thousands of them in this country at this moment, with unilateral tuberculosis, patients on whom we haven't been able to get pneumothorax or able to get only a partial pneumothorax, who are quietly going downhill, whom you expect to die in three or four years. There are thousands of cases of that sort at this moment, on whom you can advise the posterior operation for thoracoplasty.

Dr. Parfitt: I am very grateful to Dr. Archibald for his remarks. Referring to his last remark about the need of more of us doing thoracoplasty, I can only say I am entirely in accord with his statement.

Dr. Stivelman's reference to pneumothorax being lost, from the lung coming out, because of pleural adhesions, suggests that such cases should probably be considered as desirable for thoracoplasty, provided the other lung is reasonably well. I am sure I could have recommended many more for this operation in the earlier days of artificial pneumothorax treatment. We should be ready to apply this beneficial measure, and in various localities we should get some one surgeon who is interested, who will approach surgery from a medical standpoint, and thrust our cases upon him. Such a man who is worth developing should be encouraged in several centers so that this operation may be more widely used.

When a pneumothorax is being discontinued, I would make this suggestion for the possible helpfulness of phrenicotomy, having read Sauerbruch's opinion on the relative uselessness of phrenicotomy: here we may have a real use for phrenicotomy by doing a phrenicotomy on the pneumothorax side, with the idea of putting less strain for the future upon the expanding lung.

PULMONARY TUBERCULOSIS AND TONSILLECTOMY

By Alexander Armstrong, M.D.

White Haven, Pa.

In asking your attention to the reading of this paper, I realize that this audience understands very well all that is known about pulmonary tuberculosis, and those of you who have been reading the *Journal of the Outdoor Life*, should be well up on the theory of tuberculosis. Neither is tonsillectomy a subject upon which illumination is needed except when it has a deleterious effect upon a patient suffering with tuberculosis.

For many years physicians who treat large numbers of the tuberculous sick have noticed that the operation of tonsillectomy apparently lights up a dormant pulmonary lesion and intensifies an active one. During the last two years this connection has been brought to my attention so often that I consider it important enough to bring before this body for discussion.

In 1919, Dr. Slyfield of Seattle, Washington read a paper before this Association, in which he called attention to the frequency of lung abscess following tonsillectomy, or other operations above the larynx. Of 30 cases of lung abscess, 9 followed these operations. He quotes Manges who had reported nine cases of lung abscess following tonsillectomy. These experiences can be multiplied many times and prove the direct infection from tonsil to lung.

It is therefore just as easy to understand why and how tuberculous lesions in the lungs may be affected by this procedure.

Tonsillectomy has become very popular and is being performed by many who have not had sufficient training in this line of work, nor have they, oftentimes, the proper equipment to give the patient the best chance for recovery.

We must admit that the operation of tonsillectomy is necessary, but I maintain that it is rarely imperative. We all know, too, that this procedure is resorted to very often when the condition of the organ and the symptoms of the patient do not indicate it. More important still is the fact that the tonsil is removed in order to clear up symptoms which are caused plainly by tuberculosis and the evidence of this disease is either ignored or overlooked. In the series of cases I am reporting with this paper it will be seen that the operation did not relieve the patient and that instead of eradicating a "focal sepsis," the operator created a "general sepsis."

It is known that the tonsils are involved with tuberculosis in from 2

per cent. to 4 per cent. of cases which come to operation, and this is given as one of the urgent indications for removal of the organs. When we remember, however, that a much larger percentage of tonsils are found, on autopsy, to be seat of tuberculosis and that most of these tonsils caused no symptoms in the patient, we have fairly good evidence that this is not an indication for operation in every case. Neither do I believe that tonsils which are simply large from hypertrophy should be removed unless they interfere seriously with respiration. Tonsils which are proven to contain pus or other infection come under the justifiable operation class, and it is in this class where we should decide as to when and how the removal is to be effected.

From my own case records and the experience of many others it is evident that general anesthesia is still used more often than local. In the present series the proportion is four to one. It is also worthy of note that ether is still the choice of most operators doing this kind of surgery.

The deleterious effect on the lungs has been usually attributed to the anesthetic or the inspiration of pus and blood during the operation. I think practically all physicians in this line of endeavor, agree that ether should not be used for any patient with tuberculosis. This anesthetic causes bronchial irritation when inhaled, and as it is excreted largely by the lungs, it also irritates during exhalation. Doctors Brown and Petroff reported before this Association in 1919 a series of experiments which they had conducted upon guinea-pigs, which seemed to prove that ether inhalations did not cause any increase in the susceptibility to tuberculosis.

It may be the traumatism is due to the violent exertion during the inhalations in what has been termed the excitable stage. Clinical experience is all we need to persuade us to avoid a dangerous procedure. We can, therefore, make sure for our patient's benefit and exclude ether as an anesthetic.

If, however, the trouble is due to inhalations of pus, blood or other septic material, when the patient is entirely relaxed by any general anesthetic the reasonable inference is to avoid all general anesthetics in operating upon patients who have either latent or active tuberculosis. Granting, as we must, that tonsillectomy is at times indicated, what method of operation and anesthesia shall we as phthisio-therapeutists recommend?

Let us insist upon local anesthesia as the least harmful when operation is imperative. The patient being conscious, there is no danger of the inspiring of the products of the operation. This method is not always innocent of serious results as you will note by reading the case reports incorporated with this paper, proving almost surely that there is such a thing as blood-borne infection from tonsil to lung.

I am not attempting to outline a technique for this operation and will leave that to the tonsillectomists.

It is fitting, however, that mention should be made here of the excellent paper read before this Association last year by Dr. P. P. McCain of North

Carolina. He advocated the removal of tonsils by the dessication method with high frequency current. His claims are, and I believe they have been proven, that there is no bleeding or dysphagia afterward, the patient being able to proceed with his plan of nourishment. The case histories of fifteen patients, which I have incorporated in this paper, illustrate the important points which I have tried to bring to your notice. In none of them did the operation relieve the patient's condition: and in many of them the signs and symptoms were aggravated.

This list comprises a resumé of the patients under my care in the various private sanatoria in White Haven, during the past two years. Of 150 cases admitted during this period, fifteen or 10 per cent. have been affected by tonsillectomy as follows:

Case 1.—Mr. A. H., age 29, occupation, treasurer.
Had attack of pulmonary tuberculosis in 1917 from which he recovered after curing one year.
Symptoms of relapse August, 1921: Fever, loss of weight and strength, dyspnoea, etc.
Ignored obvious symptoms of active tuberculosis in lungs.
January 5, 1922 had tonsils removed. Ether anesthesia.
Came under my care January 28, 1922. Extreme septic condition from rapid dissemination in lungs. Died February 1, 1922.

Case 2.—Mrs. V. R., age 28, occupation, trained nurse.
Came to hospital at P., with history of pleurisy three years previously; frequent colds. Recently loss of voice, weight and strength. No cough.
Pus found in right tonsil. Removal advised.
Tonsils removed. Ether anesthesia. I saw her in consultation a few days later. Sputum had been examined after operation and found to contain tubercle bacilli.
Found a tuberculous pneumonia present from which she died within a few days.

Case 3.—Mrs. E. H., age 27, occupation, housewife.
Had attack of tuberculosis in 1916 while nursing baby. Recovered.
Tonsils removed in 1918. Ether anesthesia. Throat not relieved—tonsils again removed February, 1921. Ether anesthesia.
Came under my care July 1921 with both lungs involved and lesions active. This patient is making a somewhat reluctant convalescence with the aid of therapeutic pneumothorax.

Case 4.—Mr. T. C., age 20, occupation, student.
Mother had recently died of pulmonary tuberculosis.
Patient began to have symptoms of ill health and, of course, tonsils were blamed rather than lungs.
Tonsils removed September 1920. Ether anesthesia.
Came under my care June, 1921 with advanced lesions in both lungs. Death occurred a few months later.

Case 5.—Miss M. I., age 31, musician.
Had attack of supposed neurasthenia; so in August 1920 her tonsils were removed. Ether anesthesia.

November 1920 had attack of laryngitis associated with cough, so in January 1921 her teeth were removed. Ether anesthesia.
Came under my care in May 1921 with advanced tuberculosis of right lung. Still under treatment.

Case 6.—Mrs. G. G., age 31, occupation, housewife.
Taken sick in 1919 while nursing baby. Tonsils removed. Ether anesthesia. As this did not bring relief the appendix and one ovary were removed. Ether anesthesia. As she then began to have more pointed pulmonary symptoms, she was referred to me in August 1921. This patient has apparently recovered.

Case 7.—Miss G. G., age 12, occupation, student.
Had a great deal of throat trouble and a year ago tonsils were removed. Ether anesthesia.
Symptoms were not improved, continued to have colds. Referred to me for diagnosis. Found signs of tuberculosis infiltration in right upper lobe. Condition improved under appropriate treatment.

Case 8.—Mr. T. J., occupation, merchant.
In July 1920 tonsils removed. Ether anesthesia. Later appendix removed and as it was found to be tuberculous, attention was directed to the possibility of a primary focus. Examination of lungs revealed lesions which had existed for some time.
This patient has made a very good recovery.

Case 9.—Miss R. J., age 24, occupation, trained nurse.
After suffering for two years and having removed in the following order: appendix, thyroid, finally tonsils under ether anesthesia, she was referred to me for diagnosis.
I found advanced lesions of tuberculosis in the right lung, which probably antedated the various operations but was aggravated by them.

Case 10.—Mr. W. H. age 25, occupation, machinist.
In May 1921 had noticed that he was expectorating blood.
Thought it was from his throat and consulted a throat specialist, who agreed with him and recommended the removal of his tonsils.
This was done under ether anesthesia.
He came under my care ten months later with well marked cavitation in his right upper lobe.

Case 11.—Mrs. Y., age 26, occupation, housewife.
Tonsils removed April 1921. Ether anesthesia. Two weeks later blood-spitting and other signs of lung disease.
Two months later I saw her in consultation and found active disease in the upper and middle lobes of right side.

Case 12.—Miss V. S., age 25, occupation, stenographer.
Had tonsils removed in 1918. Ether anesthesia. This was followed a few weeks later by blood-spitting and since that time, September 1920, to the present, has not been well. Found on examination advanced lesions in the right lung.

Case 13.—Mrs. G. K., age 23, occupation, stenographer.
This patient had recovered from an attack of tuberculosis in 1917.

In 1920 had a relapse in which her larynx became involved. Consulted a throat specialist who advised the removal of the tonsils.
This was done under cocaine anesthesia. Immediately afterward the disease in her lungs became very active and she is still very ill.

Case 14.—Mr. A. L., age 30, occupation, physician.
Had an infection of the lungs from which he had apparently recovered. His physician, who was one well trained in tuberculosis, decided that his tonsils were diseased and referred him to a throat specialist. He decided to remove the tonsils. This was done under local anesthesia.
Within a few days a pneumonic process started in his left lung which lighted up his healed lesions, and when he finally recovered from the pneumonic process he had begun to form a cavity in his left upper lobe. Thus, through infection resulting from the operation, he was converted from an early case with healed lesions to a third stage case with active lesions.

Case 15.—Mr. C. B., age 35, occupation baker.
This case illustrates how an old chronic laryngeal tuberculosis may be excited and activated by a tonsillar operation.
Had recovered from an attack of tuberculosis in 1919 during which his larynx was affected. He had a certain degree of hoarseness but no dysphagia. Tonsils were removed in 1921 and he then came under my care with renewed activity in both lungs and larynx.
Still under treatment but has shown little improvement.

CONCLUSIONS

1. Tonsillectomy should not be undertaken in active cases of tuberculosis unless imperative.
2. A careful history should be taken of all cases about to be operated upon and a thorough chest examination made by one trained in tuberculosis.
3. Removal of tonsils often does not relieve the patient as the indisposition was caused by an unrecognised tuberculosis.
4. Ether as an anesthetic should be condemned and other general anesthetics advised against.
5. Local anesthesia should be insisted upon.

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DISCUSSION ON PAPER BY DR. ARMSTRONG

Dr. P. P. McCain, Sanatorium, N. C.: I am especially glad, Dr. Armstrong is emphasizing the dangers of reckless tonsillectomy in tuberculosis. Even when it is done under a local anesthetic and under the most favorable circumstances, I feel that it oftentimes does a patient a good deal of harm. The throat is so sore for several days that he can't take a sufficient amount of nourishment, in the first place, and then there is necessarily some shock and also there is the danger of embolism, which he emphasized.

We have been using for four years now the fulguration method, which he referred to, with uniformly good results. For the last eight months we have been using fulguration mainly in cases where we could demonstrate tuberculous ulcers in the tonsil, and in the cases which did not respond to x-ray treatment. We have been using the Witherbee method of x-ray therapy; and where there is no large amount of fibrous tissue, we get good results from the x-ray, which is even easier and less disturbing than the fulguration. But with the fulguration, if one has the patience, he can take out any tonsil, it can be made practically painless and there is no loss of blood, and no danger of embolism.

Dr. Ernest S. Mariette, Hopkins, Minn.: Our experience apparently doesn't agree with the paper read. We started taking tonsils out about four years ago, under local anesthesia only. We have had no cases made worse by tonsillectomy. In some cases there has been no continued improvement and the patient who was getting progressively worse has continued to progress and has died. We have had several patients, however, who date their improvement from the tonsillectomy, and of those several cases, one was a tuberculous peritonitis case; another one was a girl who came in with multiple cavity formation, was in bed a long time with marked disease. She made some progress and then a cold or an acute flare-up of the tubercle took place, and she began to raise two to three cups of sputum in twenty-four hours. We removed the tonsils, which were badly diseased, and in less than two weeks she was not raising enough sputum to cover the buttom of the cup. Probably that was a coincidence.

Our bookkeeper was in bed approximately six months, with no apparent improvement in regard to the physical signs; his temperature was not exceedingly high. Shortly after the tonsillectomy, his sputum became negative and his symptoms began to improve.

Probably one of the cases that encouraged me most was one of the members of the staff who had had tuberculosis for some time, was working, but needed frequent periods of rest; and when I first mentioned tonsillectomy to him, he threw up his hands in horror. Two years later he had his tonsils taken out, remained in bed a month, and the next winter had only a very short period of rest. Previous to that, he had taken rest periods very frequently.

I might also cite the case of our postmistress and of many others who date their improvement from tonsillectomy. Personally, I am fully convinced that the tonsillectomy was the turning point in their treatment and that had that not been done they would not now be working with, as nearly as we can tell, complete arrest of their case. Our experience covers a period of four years and about 50 cases. I do not know why we have not had any bad results, unless it is that the tonsils are removed under local anesthesia and then the patients are put to bed for at least a month's rest. Some receive many months rather than one.

Dr. G. C. Johnson, Evansville: I just want to ask the speaker whether he has had any experience in removing tonsils under gas. Everybody who is doing this class of work is fighting the surgeons on their methods of anesthesia, and only within the last two or three years has one of our surgeons taken up gas oxygen anesthesia. I told him he would get all my surgery. One of our younger throat men who worked under Sluder at St. Louis, has developed a method of taking tonsils out under gas anesthesia. One child of eight years took the anesthetic very badly on account of adenoids, and in that case he took out tonsils and adenoids in less than sixty seconds. He had difficulty in getting the child to sleep, but he had them both out before the child was well awake. Ordinarily he has two minutes and he figures he doesn't have to hurry a particle in taking them out in that time, and it is almost bloodless. He has very little bleeding and very little traumatism of the throat. He has taken out a good many, and I must say that so far the results have been good.

It appeals to me for this reason: That you get many of these patients needing tonsils removed, and they are of the nervous type that are not very suitable for local anesthesia.

Dr. M. J. Fine, Newark, N. J.: I would like to say a word or two in reference to the removal of tonsils in tuberculous patients. I have had two cases that I recollect. One patient died following removal of tonsils—a medical student. The physician removed the tonsils for relief of coughing caused by irritation, and after removing the tonsils, he learned the patient had tuberculosis. The other patient is now in Denver, Colorado, an advanced case of tuberculosis; he developed a tuberculous pneumonia following tonsillectomy and at the present time is in poor condition. I would, therefore, suggest that tonsillectomy not be performed unless it is actually necessary and then only with very careful attention.

Dr. Armstrong: I would like to inquire of the doctor who spoke just before Dr. Fine, how fast he runs his automobile if he can take the tonsils out in sixty seconds?

This paper does not concern so much the physicians who are in tuberculosis work, as they have recognized the lung trouble and will insist upon local anesthesia. I have said in the paper that when the operation is imperative, we should insist on local anesthesia.

The fact remains that most surgeons are still using general anesthesia—usually ether. I suppose some of you have read in last week's American Medical Journal, an article by Dr. Moore of Philadelphia, who collected 202 cases of lung abscess following tonsillectomy. One hundred and fifty-one of these cases were given ether. The point of this paper that I hope will remain with you is that there should be a careful chest examination and history taken of all cases, so as to exclude tuberculosis whether active or latent, before this operation is done or any other operation on the upper air passages.

CONTROLLING FACTORS IN LIGHT APPLICATION

By Edgar Mayer, M.D.

Saranac Lake, N. Y.

This presentation is not intended to be an argument for or against light therapy but rather a call for the establishment of a standardization of methods of application as well as a correlation of the results of various workers. The judgment of the value of light irradiations depends greatly upon such standards. With the present lack of detailed reports and proper criteria of observation, evaluation is difficult.

The value of sunlight at least for tuberculosis of the bones, joints and glands has been established by the results of Rollier abroad and of the workers at Perrysburg in America. The value of the carbon-arc lights has similarly been shown by the colleagues of the Finsen Institute, more particularly by Reyn and Ernst. The benefits derived from the use of the mercury-quartz light have also been demonstrated at least for superficial tuberculosis (Jesionek). This worth is clearly a greater one than that of mere impression. Recent results experimentally seen in the prevention and treatment of rickets in rats and infants (Huldschinsky, Shipley, MacCollum, Hess) convince us of some direct metabolic change manifestly due to natural and artificial light radiations. The specific or particular rôle that each type of light application plays and the special forms of disease that are especially adapted to these will be the aims of future investigations in this field. The mechanism of light action is not established, although the theories offered have been as multifarious and uncertain as the diseases themselves for which light has been advocated.

It is important for us to recognize at the start that in dealing with artificial sources of light, we are employing spectra very different from that of sunlight and therefore such a term as artificial sunlight is confusing and should preferably be discarded. Likewise indications for therapy with sunlight and with artificial sources of light may differ and it seems wiser not to attempt comparisons between two such different sources, but rather to attempt to learn more about the indications for each. The presence of short ultraviolet rays in the mercury-quartz spectrum and the almost complete absence of red rays offer us conditions affecting tissues in a particular way. These differ from the conditions present when employing sunlight, and the short ultraviolet rays may prove most important for healing certain types of disease, especially those superficial and readily accessible. Likewise, the spectrum of the carbon-arc although resembling that of sunlight in its visible portion, differs greatly in the

invisible. Eventually we may learn that the indications for light irradiations may differ for the various sources just as today we are approaching better standards for exact indications for radium and x-ray.

The aim of the writer is, accordingly, to suggest a working technic for more efficient application of light, which will also offer us a basis for recording and correlating our results. When irradiation is employed, exact conditions should first be classified. These may be tabulated somewhat as follows:

Patient

1. Age—Children and adults react differently.
2. Skin—Color: Blonde or brunette, etc.
   Texture: May vary in recent or old illness.
   Body hair: Presence or absence.
3. Type and stage of disease.
4. Type of tissue—Skin and mucous membrane etc. differ.
5. Pigment—Presence or absence.
6. Time of illness at which exposures are initiated.
7. Whether previous treatment without light failed etc. (This will control results better).

Source of Light

1. Intensity—Chemical and heat (Determined by various means).
2. Efficiency of apparatus—How many hours used.
3. Current.
4. Type of reflector.
5. Distance from patient.
6. Period of exposure.
7. Number and frequency of exposures.

A fairly simple and rather efficient means of measuring the intensity of chemical or actinic radiation (violet, ultraviolet etc.) is that of Bering and Meyer, which we have modified merely as to strength of solutions. This method, although not exact, can be employed for comparative estimations. Stock solutions are made up as follows:

1. Potassium iodide: 25 gm. Distilled water: 1000 cc.
2. Concentrated sulphuric acid: 53 cc. Distilled water: 1000 cc.
   Keep separately in dark bottles.
   Indicator: 0.2 per cent. solution of water-soluble starch.
   Titrating solution n/400 Sodium—Thio-sulphate.

Procedure: About 7 cc. of solutions (1) and (2) are mixed and then irradiated. Two cc. of starch solution are next added and a blue color appears. Sodium-thiosulphate is then added by titration until the end point of discoloration appears. By this means, we can compare the intensities and efficiency of the lamps and reports can be correlated. How-

ever, it is necessary to realize (as we have found) that the intensity of any burner is not constant i. e. it will vary greatly during even a two hour burning. Thus at ten minutes it may reach a temporary maximum which will rise at ½ hour and then may hold at ¾ hour and drop at 1 hour and then may rise at 2 hours. In other words, the intensity is unstable and we must take this into account when making tests. The temperature surrounding the burner as well as the temporary voltage fluctuations vary the intensity. Our comparisons were accurate where we stopped between tests and then again started the lighting.

What is the proper dosage for a local or general radiation? A consideration of determining factors seems worth while. For equally photosensitive silver-chloride papers, the effect (the amount of darkening) is proportional, within certain limits, to the product of the intensity of radiation and the period of exposure. Although the law does not apply accurately for the effect upon the body tissues, yet according to many experiments made both in photochemistry and photobiology, it can be considered as holding for the greater part. If it is probable that fluorescence is an important factor, then we should prefer a more intense source of radiation applied to the whole body surface anteriorly and posteriorly and we should desire this intensity to be as uniform as possible, wherever it strikes the cutaneous areas. However, it seems impossible at present to predict that an increased absorption will be accompanied by increased physiological effect, since we do not yet understand how radiant energy is changed to physiological action. It is even true that rickets in infants was overcome by solar exposures made only to the extremities, and that prolonged intense irradiations were not essential. The effect was a systemic one.

The most desirable period of duration of exposure is still a matter of experiment. Huldschinsky and others obtained good results in the treatment of rickets in children with frequent twenty-minute exposures (universal radiations). The results were clearly shown by x-ray, as calcium was deposited in the epiphyses. In tuberculosis as well as in rickets, the deposition of calcium is most important. The question of the possibility of overdosage with general irradiations for tuberculosis may be an important one, but fortunately in contrast to x-ray radiation the dangers from such exposures seem to be few. There are, however, some patients who do develop symptoms of hypersensitiveness to these rays. Hess found experimentally with rats that too short exposures did not protect against rickets; also a minimal dose of light that was protective for white animals against rickets proved powerless when applied to black rats. Similarly the rate of growth of an animal determined the amount of radiation requisite for protection against rickets, the rapidly growing animal showing a greater requirement of the active light rays. Overdosage as evidenced by destruction of a previously produced pigment or by marked cutaneous exfoliation may also act as our guide.

Longer intervals (two days or more) between exposures may be war-

ranted, as well as periods between courses of exposures to allow for depigmentation. It is not yet satisfactorily decided whether an erythema or a permanent pigment is more beneficial although it appears that the latter is to be preferred. Some patients, after pigment is developed, may become even refractory to the benefits derived from irradiation. However all this is mere speculation at present and must yet rest upon individual impressions.

Certain kinds of tissues are particularly responsive to short-waved irradiations, thus cartilage in the process of ossification, immature and rapidly dividing cells, regenerating tissues of wounds, cells of new-growths, sex-cells, and splenic and other lymphatic tissues. This is observed in the response of hair-follicles to ultraviolet radiation and in the marked lymphocytic changes or rapid destruction of sex-cells by x-ray radiation. Even certain parts of cells may be more sensitive to radiation than other parts—thus the nucleus more than the cytoplasm.

Small doses of radiation are generally stimulative, slightly larger doses may stop or delay physiological changes and still larger doses will destroy. What these particular doses are for the various tissues must yet be learned. With direct radiation of diseased tissues, the focal reaction and its period of subsidence are probably our best guides. Here we would aim to employ a dose large enough to destroy the diseased tissue and yet stimulate a healthy response from normal tissue.

With these points in mind, the writer attempted to make a study of comparative intensities of some sources of radiation under varying conditions to learn whether the method described above might be of practical value to all of us. According to some of the results seen below, the test itself does not appear accurate but the estimations can be taken as rough guides in making comparative observations. Fluctuations in the current or in the ability of the mercury-quartz burner to take up the current are very disconcerting at times and must be taken into consideration when making estimates. These may account for some of the discrepancies. The technic is not difficult, so that such errors can hardly be held accountable for the variations. Furstenau's actinometer (advertised abroad) is according to many writers, not satisfactory. There are some very accurate instruments that can be employed but these are either too costly or too difficult for the practitioner to employ.

To determine exposures for general radiations of the body which would allow us to obtain most uniform changes of the entire cutaneous surface, tests were made as follows: with the quartz burner placed at distances of one, two and three feet respectively, the exposed solutions in petri dishes were placed in the following positions: one at a point directly at the base of a perpendicular drawn from the middle of the burner; others at 6, 12, 18, 24, 30, and 36 inches distant from the first. The average of six such tests is recorded. This was further controlled by employing four petri dishes, closely approximated, instead of one, and these results were also fairly uniform.

These figures differ somewhat from the inverse square law of intensity variations but the difference may be in part accounted for by the instability of the current which the burner takes up from time to time. The results indicate approximately 50 per cent. loss at 12 inches with lamp one foot distant, and a similar loss at 18 inches with lamp two feet distant, and at 24 inches with lamp three feet distant. Therefore for uniform skin effects, it would be preferable to employ two radiations of the body,

INCHES FROM MIDDLE OF BURNER	DISTANCE FROM SOLUTION (INTENSITY OF 100 PER CENT)		
	1 foot	2 feet	3 feet
	c.c.	c.c.	c.c.
0	12.1	4.5	2.1
6	9.7	3.9	1.7
12	6.0	2.9	1.6
18	3.5	2.0	1.4
24	2.0	1.4	1.0
30	1.0	1.0	0.8
36	0.6	0.8	0.5

both anteriorly and posteriorly, each covering 12 to 18 inches on both sides of the perpendicular drawn from the middle of the quartz-burner. To accomplish this, the following method of exposures can be employed: Lamp is centered first over the lower part of the thorax (contraindications to direct chest exposures are questionable) and secondly over the lower half of the thigh and the same is repeated posteriorly. Furthermore since reflex or direct action upon the depths by means of fluorescent substances in our body has not yet been disproved, an additional direct exposure seems indicated over the focus of disease especially in abdominal conditions. If superficial tuberculosis is present, this receives an added local irradiation. Thus far empirical dosage is employed. The writer begins with a new lamp on low intensity, the burner placed at a distance of three feet from the body and an exposure of three minutes to every part is given. Following this, irradiations are given every day, increasing the exposure one or two minutes for every part until twenty minutes are reached (total 80 minutes) when the second intensity is employed, if the lamp is one of alternating current type, beginning then with a 16 minute exposure. With alternating current the high intensity is about 20 per cent. greater than the low; on direct current there is 100 per cent. difference. If the lamp is of direct current, patients begin with a 10 minute exposure. When twenty minute radiations are again reached, the lamp is gradually lowered, (½ inch every second day) until the burner is at a distance of one foot from the skin. (The law that the change in intensity varies inversely as the square of the distance is supported fairly accurately by the above figures). If severe burns occur—more likely in blondes than brunettes—the exposures are temporarily discontinued, this period depending upon the reaction. With older burners, longer exposures may be

necessary. It is hoped that in the future we may be able to employ irradiations upon a more scientific basis but for the present, dosage seems to rest upon individual experience. Eventually we may learn that minute doses are more desirable in certain cases, but it seems impossible to decide this now.

Further comparative tests gave us some interesting estimations in regard to some of the physical characteristics of the radiations. Sunlight at noon in Saranac Lake on a March day revealed with this test about the same intensity of actinic radiation (as determined by the liberation of free iodine) as a mercury-quartz lamp of about 300 hours usage, burned at a distance of one foot. A cloudy day under similar conditions revealed only about 25 per cent. of this intensity. Comparisons between the tungsten-anode burner (Cooper-Hewitt & Burdick burners) and the mercury-anode type (Hanovia burner) showed little difference in intensity. The carbon-arc lamp with a parabolic reflector showed with this test from 25 to 40 per cent. of the chemical intensity of the mercury-quartz burner. Hess found that exposures with the carbon arc had to be made twice as prolonged as those with the mercury-quartz light in order to prevent rickets in rats, employing minimal doses. The ultraviolet radiation from the mercury-quartz burner reaches its height of intensity only after the burner has become thoroughly heated, which takes from ten to fifteen minutes after starting the lamp. According to our results, the intensity increased somewhat after fifteen minutes burning, then dropped at one hour and was the same at 1½ hours, increasing again at two hours. The burner takes a definite current at a definite temperature and this is easily changed by temperature variations of the surrounding air, so that the burner may even be chilled by drafts. The mercury-arc generates ozone so that ventilation of a room should be provided for, but a draft over a burner itself should be avoided. Coblentz has shown that 67 per cent. of the total radiation of wave lengths less than 1.4 u constitute ultraviolet rays from a new burner. After a usage of 3,500 hours they dropped from 67 per cent. to 60 per cent. The total radiation after 3,500 hours equalled 64 per cent. of the original total. The shorter ultraviolet rays (below 300 u u) are 20 per cent. of the total 67 per cent. ultraviolet radiation. The short ultraviolet rays of the mercury-quartz spectrum constitute 6 per cent. of the total lamp radiation. The short ultraviolet rays of sunlight at sea level constitute less than 5 per cent. of the total ultraviolets and less than 0.1 per cent. of the total solar intensity. The total ultraviolet radiation of sunlight makes up about 1 to 2 per cent. of the intensity of the total solar radiation. We found that white skin of a guinea-pig about 1 mm. thick, allowed almost twice as much actinic radiation to penetrate during a fifteen minute exposure, as pigmented skin did. Rays from a Neon lamp (red rays) revealed no chemical radiation by this test during a ten minute exposure.

In conclusion it is hoped that means for more accurate dosage and technic will be available so that physiologic differences in response to

this form of radiation will be established. With this knowledge, the therapeutic value will be enhanced.

Results of Intensity Tests with Method of Bering and Meyer

1.—Mercury-Quartz lamp of 300 hours usage (mercury electrodes)

Distance:	1 foot		
Exposure minutes	5	10	15
Low current	3.1 cc.	11.1 cc.	13.8 cc.
High current	6.4 cc.	11.4 cc.	15 cc.

Distance:	2 feet		
Exposure minutes	5	10	15
Low current	3.3 cc.	7.5 cc.	10 cc.
High current	3.5 cc.	8.4 cc.	8.9 cc.

Distance:	3 feet		
Exposure minutes	5	10	15
Low current	1.8 cc.	2.5 cc.	5.9 cc.
High current	3 cc.	4.6 cc.	6.4 cc.

2.—Test made on low current, exposure at 2 feet for 10 minutes, after test made on high: Result:

Low ..... 8.3 cc.
High ..... 7.8 cc.
Here current increased in strength after long burning.

3.—Tests with four solutions exposed at one time. (Lamp burned fifteen minutes before testing.)

Distance: 1 foot.
Exposure minutes 10:

	11.8 cc.	12.3		7.4 cc	7. cc.
High current.....	12.1	12.	Low current 7.3		7.1
	12.1	12.2		7.4	7.
	12.4	12.3		7.6	7.5

4.—To show variation at different periods of burning:
Distance 1 foot, five minutes exposure, low intensity:

At Start	After 15" burning		After 30" burning		After 45" burning	
3.6 cc.	7.1 cc.	7. cc.	6.9 cc.	7.	7.2 cc.	7.6
	7.1	7.2	6.7	6.9	7.4	7.1

At Start	After 1 hr. burning		After 1½ hr. burning		After 2 hrs. burning	
3.6 cc.	7.5 cc.	7.2	7.8 cc.	8.1	6.6 cc.	5.8
	7.6	6.9	8.1	8.	6.	5.9

6.—Tungsten Anode Mercury-Quartz lamp (100 hours usage)

Distance:	1 foot	2 feet	3 feet
Exposure minutes	5″	5″	5″
Currents: Low.....	5.2 cc.	2.5 cc.	1.5 cc.
" Medium.....	6.	3.3	2.
" High	6.8	4.3	2.3

The difference between this and the mercury anode burner is very slight.

7.—Carbon-arc with parabolic metalic reflector.

Exposure 5″ at	1 foot	2 feet	3 feet
	2 cc.	1.2 cc.	1.5 cc.

8.—Exposure to sunlight in Saranac, at noon in March (snow on ground)

Exposure	5 minutes	10 minutes	15 minutes
	3.7 cc.	10.8 cc.	14. cc.

9.—Skin penetration of actinic radiation from mercury-quartz burner.
Distance 1 foot, for 15 minutes exposure:
Unpigmented skin (.2 mm. thick)—.7. cc.
Pigmented (.2 mm. thick)—.4 cc.

10.—Amount of reflection from a quartz laryngeal mirror backed with nickel, attached to a Kromayer lamp:
Distance: 2 inches

Exposure	10 minutes	20 minutes	30 minutes
	.6 cc.	1.4 cc.	2.4 cc.

11.—Neon Light (red rays)—one hour exposure
No actinic effect (by this test)

DISCUSSION ON PAPER BY DR. MAYER

Dr. Lawrason Brown, Saranac Lake, N. Y.: I want to rise to express the appreciation of all of us to Dr. Mayer for the splendid work he is doing. There is so much nonsense talked about light and it is so difficult to get real evaluation of it, that I think our thanks are due Dr. Mayer, who is trying to use this in such a way as to give us an idea of its value. It is very difficult, however, not to be led astray by its use, when you get a few successful cases.

I remember seven years ago when we first began at Trudeau the use of the violet ray in the treatment of pulmonary tuberculosis. After a few years' usage we gave it up because it did not exert an apparent influence upon pulmonary tuberculosis. I think it exerts some influence at least in cases complicated with intestinal tuberculosis.

Dr. J. H. Pryor, Buffalo: I want to compliment, as strongly as possible, the gentleman who presented this paper. There is no question that what we need more than anything else now is standardization; but we also require that we shall know the methods employed so that we

can compare results. There are the wildest claims made for results from the ultra-violet light, and like treatment, but those who have made a study of it realize that many of those claimed results are impossible. One thing that has led so many astray is that they haven't considered the depth of penetration of these different forms of light.

At Perrysburg during the last year we have been performing some interesting experiments. We began with the belief that the sunlight penetrated much deeper than we had supposed, and one of the simplest experiments that we performed was to place a photographic film on the back of the patient in a dark room, covering the films with black cloth and black paper so that the sunlight could not reach the film, and then put that patient in the sunlight with the chest exposed, and we found that we had an impression upon the plate in twenty minutes. Then, if we took a patient that had been thoroughly tanned by the Rollier method, we had an impression in ten minutes. If we used a French lens, we had an impression in five minutes. And we assumed, and to a large extent believed, that the ultra-violet lamp tans the patient and makes it easier for the other rays to penetrate the body. After using filters, we learned that the infra-reds were the ones that penetrated the body. We also found, by taking internal temperatures, that it was the heat rays that really penetrated deeply. The difficulty is that we have so very few men trained in this country in the physics of light, to reach results that are conclusive, but there is no doubt, with the interest that is being taken at the present time that in the near future we may have some standards to go by and we may know how to use these different forms of light and their wave lengths and compare results which will mean something.

For instance, in a very brief way, we hear of many strange results from the use of the Rollier treatment and when we come to converse with the gentlemen who are using it, we find they are not using it in accordance with Rollier's method.

With regard to the local use on the body, that has been pretty well worked out at Perrysburg, and we find the successful way to follow is to try to tan the body first and then try to secure a local effect afterward.

Dr. Mayer: In reference to the action of the red rays and infra-red rays Sonne has done an interesting bit of work in which he shows that the red rays when exposed to animals penetrate the cutaneous tissue and have the ability to raise the temperature of the blood without causing bodily fever. On the other hand, the infra-red rays set up a cutaneous blistering which in a sense is a safety measure protecting against an over-dose of the infra-red rays. Reasoning theoretically he, therefore, considered the heat rays as important agents for increasing the resistance against infection, acting in the same way as fever has been considered by some to act in such infections as pneumonia—namely, a better reacting patient will show fever in contrast to a poorly-reacting pneumonia patient without elevation of temperature. Of course, this is far from conclusive.

Dr. Pryor's results in regard to penetration of sunlight are very

interesting. Whether pigment can change short rays to longer and more penetrating ones is certainly far from settled, although Rollier originally offered that as his theory and on this basis considered pigment essential. Even though one may show that certain rays of sunlight can penetrate the depth of the chest, yet it will require much more evidence to convince us that tissue changes will take place as a result of this penetration. When we reach beyond one centimeter of tissue it seems probable that the intensity of the radiation that still may penetrate is very slight.

The question of general bodily radiation is one that must be worked out. The amount of electrons liberated is probably in proportion to the intensity of the radiation and the amount of body surface exposed and if we are correct in saying this, then it is in all likelihood most desirable to use the most intense radiation within certain limits and expose the largest body surface possible.

CORRELATION OF X-RAY FINDINGS AND CLINICAL DATA IN DISEASES OF THE CHEST

By F. H. Baetjer, M.D.

Baltimore

I have modified that title a little bit by putting it, "The Apparent and Real Differences in X-Ray Findings and Physical Findings," and the first thing I want to speak of is the apparent differences. For a good many years Dr. Austrian and I have been checking up every week on quite a large number of patients who were examined for tuberculosis in his clinic and it has been quite interesting to see, in reading the notes of the physical findings, the term of "slight impairment, dullness and flatness." In the cases of dullness and flatness, we have practically always found a certain amount of change in the apices. I am limiting this almost entirely to the apices because I believe in that region the clinician has the best opportunity to elicit his various signs; but with the terms "slight impairment," and "impairment," we would frequently find that the apices were absolutely clear. So, on that point one might say that the clinical examination and the x-ray differed very greatly; but when the clinician summed up his case we found then that notwithstanding there was a marked difference between what his percussion note brought out and his opinion, yet his impression of the case would practically bear out what the x-ray findings were in that particular case.

If one is working with a man and knows just what he means by those terms, there is no difficulty in checking up at all; but the trouble is, it seems to me, that in five years from now if one should attempt to write a paper upon the correlation of clinical data and x-ray findings and he were to take the notes upon percussion alone, as an illustration, and try to check them up with the x-ray findings, knowing nothing of the patients, there would be a tremendous divergence and immediately there would be a certain amount of discredit cast either upon the individual clinician who made the examination, or upon the individual roentgenologist who made the x-ray examination. So it seems to me there is a real need for a terminology which is not used as loosely as it is used at present.

The second point where we find an apparent divergence is in the question of the size of the lesion. If there is a definite lesion there, the x-ray almost invariably shows it to be actually larger than that found by percussion; but there again the clinician, through his pathological report and x-ray findings, has learned to interpret that a lesion of a certain

size is in reality much larger than his percussion findings would illustrate.

Then when we come to our real differences, we can put those practically under two heads: First, I do not think there is any question of a doubt that in certain areas of the lungs we are able to demonstrate lesions which the clinician is unable to find. For example, one of the most common places is beneath the scapula. Quite frequently we pick up areas of tuberculosis in that region. Second, not necessarily tuberculous, of course, are consolidated areas at the base. We find there the widest divergence between the x-ray and the clinical findings.

Then there is a third group of cases which we have not been able to explain. Just as an illustration, we have had one case recently (the examination made by an extremely competent clinician) where there was a definite pneumonia present. This pneumonic consolidation of considerable size ran on for a number of days; it went through the ordinary resolution, but throughout that entire period of the examination the x-ray examination was absolutely negative, not a single trace or suggestion of a consolidation could be made out. This is something that I am absolutely unable to explain. I am thoroughly convinced, from the x-ray standpoint, that there was no pneumonia there. The clinician, who is a very able man, is just as thoroughly convinced that there was a pneumonia there. We were at opposite points. Unfortunately, the patient got well, so we were unable to find whether we were right or wrong.

Another place where I think there may be a divergence and where the x-ray may be of great value is in chronic fibroid tuberculosis. It is perfectly true that at the time the patient is taken to have an x-ray made, the patient has practically no symptoms, but we have found that we have aided the clinician in that we have found an area which might be looked upon as a source of potential danger; and I think under those circumstances, where the clinician hasn't found it by his physical findings, with the x-ray findings, his outline of treatment has probably been very materially modified.

Of course, it seems to me always rather foolish to begin to talk about the value of the x-ray and the value of the clinical signs, because we ought not to separate them; they should go hand in hand; and I think we have to look upon the x-ray examination as just simply one link in the chain of evidence, and for any patient to be sent to a sanatorium upon an x-ray examination alone, I think is wrong. The ideal method is, of course, the conjoint method.

Then there is one other place in which I think the x-ray does not help us as much as we would like it to help us: that is, in these old tuberculous lesions where we have repeated flare-ups. I have a personal friend who is a member of the same hospital with which I am connected; a man of about sixty. In the last twelve years he has had four or five exacerbations of his tuberculous lesion. He has a very extensive lesion. He has been under treatment at Saranac, and as a matter of curiosity we have been comparing plates taken to-day with those taken twelve years ago. As activity is evidently underneath the consolidation that

we see, there is no way to determine that there has been any increase in the disease; so that notwithstanding the patient has had repeated flare-ups, if you superimpose one plate over another, there is apparently no difference at all.

I simply want to sound this note of warning—probably I am a pessimist, but I do feel that so frequently in x-ray examinations we take what is found there as the Law of the Medes and the Persians, and one sees too frequently patients condemned to sanatorium treatment on x-ray examinations where there is no question, in the light of subsequent examinations, that the lesion that we were dealing with was not tuberculosis but some other chronic non-tuberculous infection.

Another place where we fall down is that we have had a certain percentage of cases that come in with hemorrhage. Here the clinician can establish his diagnosis, and we find lungs which are absolutely clear: yet, six or eight months later we begin to see slight changes, which at that time we can say were tuberculous, when during the period of hemorrhage the lungs were absolutely clear.

CORRELATION OF X-RAY FINDINGS AND CLINICAL DATA IN DISEASES OF THE CHEST

By Henry K. Pancoast, M.D.

Philadelphia

The thorax presents the most interesting and widest field for x-ray study of any portion of the body, but chest diagnosis can still be regarded as in a developmental stage in many respects. In certain conditions, as cardiac enlargement, aneurysm, mediastinal tumors and pleural effusions, the x-ray diagnosis is usually obvious and positive. In many other conditions it is difficult, however, and accuracy requires long training and experience. There are many conditions in the chest which present quite similar appearances, and many pathologic processes closely resemble variations of the normal. Diagnostic ability must be based upon an intimate knowledge of anatomy of the chest, histology of the lung, pathology, experience in interpreting the evidences of disease and a thorough familiarity with normal x-ray appearances and variations within normal limits.

The best proof of accuracy is in knowing whether one is right or wrong in the interpretations made, and the most valuable experience is founded upon proof of this kind. Confirmation of x-ray interpretations can be obtained only by autopsy, the subsequent clinical course of the condition and by checking up the findings with those of the clinician. In many conditions, such as tuberculosis for example, autopsy findings are of comparatively little importance in the long run, for the reason that the cases which are likely to come to autopsy are not those in which accurate diagnosis is so essential as it is in those which present earlier manifestations of the disease and have chances of getting well if correctly diagnosed and treated. Under such circumstances it is for the best interests of the roentgenologist, the internist and the patient to regard the x-ray examination as one of the important means of diagnosis among many others and to work out the problem by correlation of x-ray and clinical data. To do this in a harmonious manner is a continuous education, which, if continued indefinitely, builds up the most valuable kind of experience, and enhances rather than depreciates the value of both x-ray and clinical methods.

Unfortunately all roentgenologists and internists are not of equal diagnostic ability. The best of each group usually work together admirably. The mediocre roentgenologist is of little service to the expert clinician; too much burden and responsibility may be placed on the expert roentgenologist when associated with the mediocre internist,

although the former may in a measure check up the latter; if both are of mediocre ability, their results are hardly worth considering, except from the standpoint of the hardship wrought upon the unfortunate patient.

The roentgenologist and internist working harmoniously together will work out difficult problems which have no other solution. There are several groups of conditions in which co-operation will work out advantageously in different ways. The study of the average case of pulmonary tuberculosis can be carried out in a perfectly satisfactory manner by the internist, and yet the x-ray examination can be used to advantage quite frequently in presenting confirmatory evidence of the clinical findings, especially where more or less doubt exists. Moreover, it may show something that has been overlooked and entirely unsuspected.

It must be given its proper place, however, and one should not carry it beyond the limits of accuracy. The internist should be assisted in his diagnosis and the roentgenologist will add to his experience. This may be an opportune place to sound again the warning against dependence upon the roentgenogram for the decision upon activity and quiescence in tuberculous lesions. The x-ray plate does not show toxemia but the effects upon the lung structure produced by the disease at whatever may be the stage of the disease at the time of the examination. Treatment must be based entirely upon the clinical aspect of the case. If the roentgenologist will accept this conservative attitude, he will have far more cases to examine than if he flaunts the virtues of his diagnostic abilities above all other methods.

Many internists have unfortunately taken the attitude that the roentgenologist should present the report of his findings and go no further, and should be kept in ignorance of the clinical aspect of the case. This really places the burden of interpretation more or less on the internist. Many conditions present similar appearances which must be differentiated by the assistance of clinical data. Passive congestion, syphilis and some neoplastic processes are frequently very difficult to differentiate upon the x-ray plate, but certain clinical data make the interpretation easy. Subdiaphragmatic abscess is an easy diagnosis as a rule when the history of the case is known. Central empyemas sometimes closely resemble cardiac enlargement or pericardial effusion and cannot be differentiated without clinical data. The chest of the child may present an appearance suggestive of a very grave condition, and yet the knowledge of a previous infection may indicate that the suspicions of gravity are entirely unfounded.

The x-ray examination very frequently supplies the one point lacking in establishing the diagnosis. This is very frequently experienced in the early stages of lobar or bronchopneumonia, miliary tuberculosis and small localized pleural collections.

Such a discussion of the value of co-operation could be carried on for a long period of time. The x-ray examination of the chest has come to

stay, but its value, scope, and accuracy will continue to increase with roentgenologic and clinical co-operation.

The Chairman: These two papers, one by Dr. Baetjer and the other by Dr. Pancoast, are now open to discussion.

DISCUSSION ON PAPERS BY DR. BAETJER AND DR. PANCOAST

Dr. Pancoast: As to the basal conditions that Dr. Baetjer mentioned, the base is a very interesting part of the chest and a very difficult field for both the clinician and the roentgenologist. I have had exactly the same experience as Dr. Baetjer has had, many times finding something in the base and no clinical evidence of it, but more often having clinical evidence of a definite process going on in the base and then having no x-ray evidence of it whatever. That has occurred time and again.

Dr Kennon Dunham, Cincinnati: I think we have all learned a great deal from what Dr. Baetjer and Dr. Pancoast have said as to the necessity for recognizing the normal chest, the necessity for recognizing the limitations of the x-ray and the limitations as well of a physical examination. When we start out on the basis to have the physical examination know it all, or start out to have the x-ray know it all, or to forget other laboratory means of making a diagnosis, we are going wrong. On the other hand, we can read an x-ray plate alone and drop it almost regularly into four classifications. That isn't a diagnosis, but you can drop the plate into four classifications: 1. from an x-ray standpoint, negative, an absolutely normal chest, normal chest expansion; 2. tuberculous; 3. normal lesions not tuberculous, and 4. unknown. When these plates are dropped into these classifications from the light of x-ray and physical examinations, they act as a great source of help; in other words, they act as a great precipitant to start out your examination. I will go back to what Dr. Brown said a while ago: that no examination is complete without a stethoscopic examination of the chest and I would like to add a corollary that no x-ray examination of a chest in itself makes a chest diagnosis.

Dr. F. H. Heise, Saranac Lake: I don't think there is any question at all but that physical signs are fallible and that the x-ray is fallible. I think any one who has practiced both methods realizes this. I don't think there is any more firm believer in the value of the x-ray in the diagnosis of pulmonary conditions than myself. At the same time I would say that the x-ray does not always give you the complete information you desire.

If one goes into this study from the side of physics, one can easily see that there are numerous reasons why physical signs cannot give you evidences that are shown by the x-ray, and for the same reason

there will be good grounds why the x-ray will not show you what the physical signs will give you. The two cannot and ought not always to correlate; and I would no more think of diagnosing any case without the use of both physical signs and the x-ray than I would of making a diagnosis without the use of the examination of the sputum or taking the history.

There are men, I know, who decry the use of the x-ray; there are those, I know, who say that the physical signs are by far the most important and the ones to be relied upon, but I can only say that if you want to practice medicine in truth, you must use both; you must not be prejudiced, you must not think that the physical signs are the only ones to be relied upon, nor must you believe that the x-ray is the only thing to be relied upon.

I think Dr. Pancoast and Dr. Baetjer have both brought out very important facts in the relation of the findings by x-ray to those by physical signs. I do think it essential that the physician have quite an adequate knowledge of the principles of and the physics of roentgen technique interpretation, if he wishes to practice medicine correctly—at least, diseases of the chest. I don't think that the phthisiotherapist should leave to the x-ray man the entire interpretation of the x-ray plate.

It is certainly true, however, that when a patient applies for admission to the Trudeau Sanatorium and we wish to diagnose his case, we do not accept the evidence which has been written down by another x-ray man; we say, "Let us see the plates." We do this because we recognize, as the other speakers have said, that there are mediocre and even less valuable x-ray men. We do not accept the physical signs of other men, but we examine the patient ourselves because we realize that there are mediocre and even less valuable "physician sign" men; but when you have established your own standards, I think it is entirely essential that you use those standards in the application of your methods in arriving at a diagnosis. I don't think that you can accept the x-ray report of the roentgenologist nor the physical signs of the clinician in all instances.

Certainly I would like to emphasize again that from the point of physics, I don't see any reason, nor has anyone shown to me any reason, why the physical signs and the x-ray should alway jibe; and certainly when in the use of physical signs you deal with slight evidences of percussion, slight evidences of changes in breathing, I think you are traveling in a field which is most doubtful of interpretation. I find that so in my work. I find myself repeatedly detecting changes in breathing which, without the x-ray, would make me think the patient had tuberculosis, whereas after taking the x-ray, no evidence to substantiate the thought is found. Then, after considering the case from the standpoint of sputum examination and blood examination and from every angle that we can possibly examine the case, the final diagnosis is non-tuberculous.

I know if I can do this, others can, because I do try to listen to the physical signs as best I can.

Dr. Alexius M. Forster, Colorado Springs: When so gentle and kind a friend of the clinician as Dr. Baetjer offers a suggestion, I think that we all ought to listen. After over a hundred years in the development of physical diagnosis of the chest and after the number of years that we have been associated together in this Association, I think it is worthy of criticism that we have no common language in describing the physical signs which we find in the chest, and I am very glad that Dr. Baetjer brought out that point because certainly if we have a right to criticize in any way the x-ray man, that is the chief point of criticism which we can make in regard to the clinician.

Dr. Baetjer: I have only one word to say and that is in reply to Dr. Heise. Dr. Heise makes the point that he thinks the phthisiotherapist should know something about x-ray. I agree with him absolutely, but I do think this, and I think it very strongly: that where it is possible the clinician ought to write down his own findings and the x-ray examination ought to be an independent finding, and then the two should be compared. I don't think it is humanly possible for anybody to go to work and practice two branches and look at them in an unbiased way and say, "My physical findings are such." If he makes his physical examination first and reads his plate, he is going to read his physical findings into the plate. If the roentgenologist knows the physical findings, he is going to read the findings in connection with them into his plate. Make the examination so that the two will go together and then read your findings, and I think you will get the results you are after.

Dr. Pancoast: I agree with the remarks Dr. Baetjer has just made as to the best way of making a correct diagnosis. All too often clinicians have asked for our reports and said, "You are wrong," intimating that they were right; instead of getting together and seeing which one of us was right, and, if one of us was wrong, finding out why.

TUBERCULOUS ULCERATION OF THE INTESTINE A CLINICAL AND POST MORTEM STUDY

By H. Schwatt, M.D. and M. Steinbach, M.D.

New York

The limited time at our disposal permits us to present only a summary of some of the more important features of our study which is based on the clinical symptoms and the post mortem findings in 117 cases of tuberculous ulcerations of the intestinal tract.

PATHOLOGICAL

Intestinal ulceration secondary to chronic phthisis is found in from 60 to 90 per cent. of large series of autopsies. In our cases from the Montefiore Hospital it was present in 117 or 64 per cent. of 183 consecutive autopsies.

The order of frequency of ulceration in the various subdivisions of the tract was: ileum (87 per cent.), cecum (67 per cent.), colon (56 per cent.), jejunum (38.5 per cent), appendix (29 per cent.), rectum (13 per cent.) and duodenum (2 per cent.).

In 80 per cent. the ulceration involved more than one subdivision of the tract and in 70 per cent. both the small and the large intestine.

The small intestine (89 per cent.) was more frequently involved than the large intestine (78 per cent.).

Involvement of the small intestine alone (21 per cent.) was approximately twice as frequent as of the large intestine alone (11 per cent.).

Ulceration of the jejunum without the ileum is extremely rare; of the cecum without the colon more frequent.

Ulceration limited to one subdivision of the tract occurred in the ileum 18 times (16 per cent.), in the cecum 4 times (4 per cent.), in the rectum in two cases and in the jejunum once. Sole ulceration of the appendix or the colon was not met with in our series.

The most frequent combination is of the ileum and cecum with or without involvent of other divisions of the tract (58 per cent.). The ileum and cecum alone were involved 13 times (9.5 per cent.). Ulceration above the ileocecal valve and of the colon without involvment of the cecum occurred 8 times (7 per cent.), of the appendix without the cecum 4 times. Ulceration of the appendix is as a general rule a direct extension from the cecum.

The lower ileum and the cecum are the areas of predilection of the primary localization of tuberculous ulceration. In involvement of the

ileum or the cecum only or of both only the ulcers are as a general rule few, discrete, recent and small. In wide-spread ulceration of the tract, the ileum and the cecum are most usually the seat of the oldest and most advanced involvement.

Healed ulcers are rare in lethal phthisis. A tendency to healing, often quite marked is more frequent and may be found alongside of extensive, advanced and progressive ulceration in the same or other parts of the tract. Constriction of the gut resulting from healing ulceration was found in only one of our cases in the lower ileum.

The serosa reacts to and indicates the underlying ulceration by patches of injection and miliary tubercles in the course of the lymphatics, usually the more pronounced the deeper and more extensive the ulceration. It may, however, present a normal appearance with extensive and advanced ulceration.

Although the ulcers quite frequently involve all the coats of the intestine and extend to the serosa, perforation is comparatively infrequent. It occurred once in the jejunum, twice in the ileum and twice in the appendix.

Advanced intestinal ulceration may be complicated by a localized peritonitis with fibrinous or fibrino-caseous deposits on the serosa and with various degrees of serous or sero-fibrinous effusion. Matting together of loops of intestine occurs. General peritonitis with purulent effusion usually results from perforation but may develop without it. Localized abscess walled off by adhesions is frequently found with perforation or advanced ulceration of the appendix.

The mesenteric lymph nodes are enlarged and tuberculous in about 60 per cent. In about 10 per cent. they are caseated and occasionally some are calcified. The changes in the mesenteric glands do not bear any direct relation to the severity and extent of the ulceration.

CLINICAL

Among the last 2,000 patients admitted to Bedford Sanatorium a diagnosis of tuberculous enteritis on ordinary clinical symptoms was made in only 16 cases of which 11 were far advanced and 5 moderately advanced and rapidly progressive, indicating that this complication is extremely rare in the early stages of pulmonary tuberculosis.

In 135 patients at Montefiore Hospital, all far advanced and mostly progressive cases, careful investigation of clinical symptoms referable to the intestinal tract revealed 13 cases in which a definite diagnosis of tuberculous enteritis could be made. In 11 other cases symptoms suggesting it were present, not sufficiently marked or constant, however, to justify a definite diagnosis.

In the 117 cases in which ulceration was found at autopsy a diagnosis was made only 40 times although in the majority of the clinically non-diagnosed cases the ulceration was extensive and far advanced.

Our experience agrees with that of other observers, that the majority

of cases of tuberculous enteritis go on to a fatal termination without having presented during life any symptoms on which a diagnosis of this condition could be based. In from one-half to two-thirds of the cases the diagnosis is made on the autopsy table.

The clinical symptoms of tuberculous enteritis make their appearance during the terminal period of the pulmonary disease, usually within from three to six months before exitus although advanced and extensive ulceration had undoubtedly been present for a considerably longer period.

The most important clinical symptoms of tuberculous enteritis are colicky pain, diarrhoea, or diarrhoea alternating with constipation, tenderness and pain on palpation and the presence of palpable thickening in the ileo-cecal region. Dyspeptic symptoms are so frequently associated with pulmonary tuberculosis that no value can be attached to them in the diagnosis of or in suggesting enteritis.

Sufficient attention has not been given to the significance of constipation in the diagnosis of intestinal tuberculosis. The onset of persistent constipation, especially when associated with occasional colicky pain or an irregularly high temperature and rapid decline in a patient who has been doing fairly well is strongly suggestive of intestinal ulceration particularly of the small intestine and of the ileo-cecal region. Constipation, however, does not appear to have any relation to healing and contraction of the gut.

The onset of severe and persistent diarrhoea or diarrhoea alternating with constipation in far advanced phthisis points with a great degree of certainty to tuberculous enteritis. Neither its occurrence nor its severity, however, bear any relation to the degree or extent of ulceration.

The occurrence of diarrhoea does not appear to be dependent to any great extent on the seat of ulceration. It may be present in ulceration of the small intestine alone. It is about two and a half times more frequent in ulceration of the large intestine alone. Most frequently it indicates involvement of the colon below the ascending portion. We do not believe that diarrhoea alternating with constipation is a pathognomonic symptom of involvement of both the small and large intestine.

Pain of a colicky character at first more or less generalized and occurring at irregular intervals and later more localized and continuous and tenderness on deep palpation combined either with diarrhoea or diarrhoea alternating with constipation or with severe constipation and the symptoms mentioned above definitely point to tuberculous enteritis.

Tenderness on palpation and rigidity of the abdominal wall indicates severe intestinal ulceration with secondary peritonitis.

Peritonitis secondary to tuberculous enteritis may also run a latent course and remain undiagnosed in a suprisingly large number of cases.

The occurrence of perforation is rarely recognized clinically in the far advanced terminal stages of the disease.

Involvement of the appendix does not give rise to the usual symptoms of appendicitis and may run a latent course in the presence of extensive destruction, perforation and abscess formation.

Blood in the stools occurs infrequently and is probably derived from ulceration of the lower portion of the large intestine. Dangerous or fatal hemorrhage is an extremely rare complication.

The presence of tubercle bacilli or of occult blood in the feces is of no diagnostic value.

Our experience with x-ray diagnosis of tuberculosis enteritis is limited. We do not, however, find it of great value especially as a means of localizing the ulceration. Although the x-ray may indicate a pathological process in the ileo-cecal region it gives no information of coincident involvement of the small intestine or of the colon, nor of early limited ulceration in any part of the tract. It may therefore be considered as of some academic interest but of very little practical importance.

Treatment can be only palliative. For obvious reasons, operative interference may be dismissed as futile and unjustifiable in tuberculous enteritis secondary to chronic pulmonary tuberculosis, because of the impossibility of localizing early ulceration, and because by the time a definite clinical diagnosis is possible there already exists, in the overwhelming majority of cases, an extensive involvement of many portions of the tract.

Light treatment of tuberculous enteritis has of late come into prominence and unfortunately has been given a good deal of undeserved credit for therapeutic value. We have given treatment by artificial sunlight a fair trial in cases of tuberculous enteritis and peritonitis at Montefiore Hospital and our conclusions are that its reputed beneficial effects become evident only when the patient has reached a state of euphoria more or less immediately preceding the termination of the disease. It is perfectly natural that manufacturers of artificial sunlight appliances should advertise its value in pulmonary tuberculosis and all its complications. The enthusiastic advocacy of this treatment by physicians is, however, difficult of explanation.

Calcium chloride intravenously, now being advocated for the treatment of hemoptysis, emetic cough and many other conditions has, we believe after a thorough trial, no appreciable value as a palliative in tuberculous enteritis.

The prognosis of this condition is invariably bad and the onset of definite and persistent clinical symptoms marks the beginning of the end.

DISCUSSION ON PAPER BY DR. SCHWATT

Dr. Lawrason Brown, Saranac Lake: I am very much interested in this paper. We owe Dr. Schwatt a debt of gratitude for his careful autopsy studies. I cannot fully agree with his conclusion about the treatment of intestinal tuberculosis. It takes us back to the position where we were a number of years ago, when we knew nothing about intestinal tuberculosis clinically, when we could not diagnose it, and when we might as well have thrown up our hands and sat down and watched the

patient and said, "Nothing can be done." Personally,I don't believe that is true now. Mr. Sampson and I have studied now 1,036 cases in regard to the roentgenological diagnosis of intestinal tuberculosis. Of these, 89 were studied routinely as they entered the Trudeau Sanatorium, to see with what frequency intestinal tuberculosis occurred in early cases. By this method of diagnosis we discovered 5 positive cases in the 89 mentioned. Of course, a method like this has to be checked up. Of the 323 positive cases, 39 came to operation and 4 to autopsy. Of these cases, the x-ray was correct, I think, in all save one, and in that case we had made a diagnosis of a filling defect in the middle of the transverse colon, which we feel now is an unsafe thing to do. Fortunately for this method, tuberculosis of the intestines usually begins, as the speaker has said, around the ileocecal region. On the negative side we have had 24 cases come to operation and 2, I think, to autopsy, and these were correct and agreed with the x-ray diagnosis as to the presence of the disease, save in 2 instances. One of these had a tuberculous appendix and a very slight ulceration extending over on to the cecum. It was so small that a "glorified" appendectomy removed all of the disease. The other case was one that we simply could not explain. It showed extensive tuberculous enteritis and colitis at operation.

We had in mind in this work, of course, operative procedure and we felt that the cases we were operating on, when we began this study, were so hopeless that nothing would do them any good. An earlier diagnosis was necessary. We tried short-circuiting and excision, and we tried later the method of Dr. Archibald, namely, to make a double mucous fistula, bringing the two ends of the affected intestinal loop out through the abdominal wall. That is a very unpleasant thing for the patient but far to be preferred to an artificial anus. Therefore we were led to the use of heliotherapy, and I entirely disagree with what the speaker says, that it produces no effect. I am thoroughly convinced that heliotherapy does produce some effect. For instance, we treated, in the village of Saranac Lake, 27 patients who came under my charge by the ordinary hygienic and dietetic treatment, and of these 22 died. We treated by violet ray a group of 51 cases and of these 31 are living. We then made a study of these latter cases to see what the results were, i. e., whether the patient was yet alive and how long we had treated them. Some of the cases we found, who were alive and were all right, had been living for three or four years after the diagnosis had been made. We subjected a number of these patients again to x-ray studies and we showed the other day in Washington before one of the medical societies a number of lantern slides showing how patients who were positive when we made the diagnosis, became completely negative later on. The change was not always immediate, as it took some time to do it—perhaps a number of months. Dr. Schwatt's argument, if I understood him correctly, was that it was impossible to expect any treatment to do much good for patients so extensively affected as many of those he studied. He implied that a *laissez faire* policy was justifiable. With this I cannot agree.

Hardly any one here would attempt to state that because at autopsy in patients dying from pulmonary tuberculosis the lungs were found so extensively diseased there was no use in trying to treat early cases. Indeed from such studies, valuable as they are, I feel that no conclusions whatsoever can be drawn as to the treatment of the earlier stages of the disease. Without a method of diagnosis helpful in the earlier stages of pulmonary tuberculosis the treatment would not have advanced nor would the results have been bettered over what they were years ago. The same is true of intestinal tuberculosis as a complication of pulmonary tuberculosis. It must be diagnosed and treated in an early stage or we shall find the condition so well described by Dr. Schwatt that leaves him hopeless of any benefit of any treatment. I fully agree with him that when such advanced stages are reached all treatment is futile.

Dr. Schwatt: Of course we all realize that any work that is being done by Dr. Brown (and I say it in all seriousness) and his associates, we have to pay a good deal of very serious attention to. However, it seems to me that in our pathological findings in cases of early ulceration and localized to one subdivision of the intestinal tract, either the jejunum or the ileum, we will have to be more strongly convinced that the x-ray is capable of diagnosing a few, two or three or four, very small ulcerations from one to two millimeters in diameter; we will have to be very strongly convinced of that.

The only purpose of an x-ray diagnosis is, as Dr. Brown has said, for treatment, and we do not believe (I must reiterate the statement) that in the early cases of ulceration in which a localization of the disease would be of value, the x-ray is as yet capable of doing that.

So far as heliotherapy is concerned, it is a very tender subject to touch upon. Of course, we understand very well that treatment with the quartz lamp is being given by men of excellent medical and scientific reputation, but it has been, and it must remain, a mystery by what line of reasoning or investigation they have reached the conclusion that the lamp treatment has proven to be of any value in advanced ulceration of the intestinal tract; I think there is no doubt that early ulceration is very rarely diagnosed clinically. When the symptoms appear, in the great majority of cases, the ulceration is so far advanced that light or any other kind of treatment is of no value.

The other day we had a necropsy on a patient who was treated by the lamp; we counted the ulcerations and we stopped at eighty-seven because we didn't have time to count any more.

FURTHER STUDIES OF ROENTGENOGRAPHIC PLEURAL ANNULAR SHADOWS IN PULMONARY TUBERCULOSIS

By J. Burns Amberson, Jr., M.D.

Loomis, N. Y.

In a paper[1] presented before this Association at its last annual meeting evidence was offered to support the hypothesis that, in a large majority of instances, so called roentgenographic pleural annular shadows accompanying pulmonary tuberculosis do not represent localized pneumothoraces secondary to lung rupture but indicate, rather, the presence of simple chronic or subacute localized pleurisies with or without localized retraction and separation of the pleural layers. Clinically it was shown that the shadows develop and enlarge as accompaniments of active intrapulmonary disease and decrease or disappear as the disease becomes quiescent or retrogressive. The evidence was based chiefly on the factors of location, frequency of incidence and roentgenographic characteristics of the shadows, related pathologic and physical features and absence of typical clinical symptoms. Since this time our studies have been continued and amplified without discovering any evidence that would seem to controvert the hypothesis stated. It has not been possible to study the condition postmortem, largely for reasons named in the original paper. We are able, however, to place on record several additional observations that are of some significance.

The first of these is that we have proved in one case that the fluid accompanying the peculiar pleural lesion was of the character of an ordinary serous effusion. The roentgenogram showed a large annular shadow, in the dependent portion of which a fluid level was noted. Shortly afterward artificial pneumothorax was induced on the same side by Dr. W. C. Blake of the sanatorium staff. The pneumothorax needle was introduced approximately at the lower border of the process as localized by stereograms and, on aspiration, about ten cc. of a clear, straw-colored fluid were withdrawn. A subsequent manometric reading recorded an intrapleural pressure of—23 cm. of water, an unusually marked negative pressure. Four hundred cc. of air were introduced without difficulty with a final manometric reading of—2,—12.

In two cases we have observed the development of these shadows during the resorption of homolateral pleuritic effusions. No pleural shadows were seen at these locations in roentgenograms made shortly preceding the appearance of the exudates. Exploratory thoracenteses and labora-

tory studies proved the tuberculous character of the serous fluids. Within two or three weeks after the effusions started to resorb, the roentgenograms demonstrated the appearance of a pleural shadow in each case; in one the shadow was annular and in the other it was roughly triangular. In both instances the shadows disappeared as the pleurisies proceeded to heal. These observations tend to strengthen the localized pleurisy hypothesis since the shadows appeared at a stage when we know that plastic fibrinous and granulating deposits are commonly found on the pleural surfaces and disappeared when it could be safely assumed that further resorption and organization of these deposits had taken place. From one point of view it might be argued that these were exceptions to the general rule that the shadows develop only as accompaniments of active disease, for the pleural lesions here were retrogressive, but, in answer to this, it may be emphasized that the entire processes were uniquely pleuritic and, as regards intensity, bore little or no relationship to the homolateral pulmonary lesions.

Since the publication of the preliminary report[2] of the work of Barlow and Thompson in which it is held that pneumothorax is the rule rather than the exception in pulmonary tuberculosis we have been even more alert in our efforts to detect this condition. Pending the publication of the full report one cannot take issue on this point but there are several phases of the problem on which our studies may shed some light. These authors found the trachea and mediastinum deviated towards the side affected by the presumed small pneumothorax, a finding that is contrary to the physical laws usually accepted as governing the condition. Barlow and Thompson assumed that annular shadows in the pleura constitute one of the easily recognized indicating signs of pneumothorax but, so far as these particular shadows are concerned, we have failed to find that deviations of the trachea or mediastinum follow any such rule as that stated. In a group of more than 100 annular shadows, the pleural location of which was proved as far as possible by serial stereograms, the deviations were directed either toward or away from the shadows depending in almost all cases on the obvious contraction of adjacent fibrous tissue. In a number of instances deviation was noted only after the annular shadow disappeared leaving at its site an evident thickening of the pleura.

In this series of cases the physical findings have not coincided with those mentioned by Barlow and Thompson. If the annular shadow is situated in an interlobar fissure there appear to be no peculiarly typical physical signs, but if it lies in contact with the parietal pleura in an accessible region of the chest wall, the character of the signs may be quite noticeable. It is doubtful if there is any definite alteration in voice or breath sounds that cannot be explained on other grounds. The most striking finding in our experience is the presence of numerous superficial râles most marked directly over the site of the shadow and fading out beyond it. The râles are most prominent as the shadow develops and

enlarges and, in several of our cases, they have entirely disappeared as the shadow disappeared. Such findings are directly opposite to those reported by the authors cited; they noted a reduction or complete suppression of râles over the affected area and so designated them as "partly suppressed râles" or "collapse râles." We are not willing, however, to draw broad conclusions from our physical examinations until our study has been further extended.

Throughout our series of investigations we have rarely noted clinical symptoms, accompanying the development of pleural annular shadows, that could be construed as indications of lung rupture. This, together with our other observations, compel us to cling to the belief that complicating pneumothorax is not nearly so common an incident in the course of pulmonary tuberculosis as is presumed by a number of recent writers.

REFERENCES

1. Amberson, J. B., Jr., Amer. Rev. Tuberc., 1921, v, 723.
2. Barlow, N. & Thompson, J. C. ibid., 1921, v, 611.

DISCUSSION ON PAPER BY DR. AMBERSON

Dr. Kennon Dunham, Cincinnati: This is very beautiful work and I hope it will go on. Ever since the doctors at Saranac called our attention to annular shadows we have all been looking at them. I don't know what they are due to; some of them are very elusive, but I do want to make this particular warning: That a great many of them that have not only been worked out in our laboratory but that have come to autopsy, are cavities and you mustn't overlook the seriousness of some of these cavities by thinking that they are simply annular shadows. Don't let me put myself into the position of trying to discredit annular shadows, but I do say that when you have an annular shadow or a circular ring of increased density, with fluid at the bottom which moves over from one side, that must either be a cavity or a pneumothorax with fluid in it, and how anybody can think of anything else I don't know. Nevertheless, whatever you conclude finally, don't forget that a great many of those things, when the lung has collapsed, stand out, in the apex in the lower lobe, as a definite cavity and must be so treated.

Jean Kieffer, Norwich, Conn.: I would like to ask Dr. Amberson if he does not think it possible that in one of the cases in which he reports aspiration into a pleural annular shadow, the pressure reported, namely a negative pressure of 23 cm. of water, might have been due to the fact that the pressure was recorded after aspiration had been performed.

Dr. Amberson: In answer to that last question, such an explanation is quite possible, and I simply mentioned the manometer reading as a finding. Of course, I think that possibly some of these shadows are due to cavities, but if you study them by serial roentgenograms, as has

been shown here, and these tremendously large shadows disappear within a space of a few weeks or months, they certainly cannot be cavities. So I would urge that where you do see these things, you take serial pictures of them. Of course we need more autopsies, but to distinguish this condition by autopsy, it is necessary to operate very carefully. If it is a localized pleuritic condition, it is quite obvious that in tearing out the lung the process will be destroyed, and for that reason I hope that where these shadows do show up on x-ray, careful pains will be taken to distinguish them.

A PRELIMINARY REPORT ON THE TREATMENT OF SO-CALLED SURGICAL TUBERCULOSIS BY DEEP X-RAY THERAPY*

By John H. Pryor, M.D.

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AND

Horace LoGrasso, M.D.

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The reports from the German surgical clinics on the successful treatment of malignant disease and so-called surgical tuberculosis by intensive x-ray therapy are attracting wide attention. American observers who have visited these European clinics have returned very favorably impressed and some venture the opinion that deep radiotherapy is not only here to stay, but that machines will be used, the voltage of which will be limited only by the voltage capacity of the tube.

Our interest in this form of treatment was aroused by Dr. Hans Holfelder of Professor Schmieden's Clinic of the University of Frankfurt-am-Main, during his recent visit to the United States. Through the courtesy of Dr. Harvey Gaylord of the New York State Institute for the Study of Malignant Disease, we had the opportunity of working several weeks with Dr. Holfelder and of observing the results of deep x-ray treatment in surgical tuberculosis.

In presenting this preliminary report, we realize that the time has been too brief and the number of cases treated too limited to warrant any definite or final conclusions. However, our results thus far have been so favorable and those obtained in Germany so apparently decisive, that we offer at this time a brief report on the thirty cases of surgical tuberculosis that Dr. Gaylord has so kindly enabled us to radiate under expert supervision.

In selecting our cases, we chose those that had not responded satisfactorily to sun-cure and those that had not yet received heliotherapy.

The two big factors in this short wave-length radiation are high voltage and heavy filtration, which, together, make homogeneous doses in deep lesions, possible (a condition desired for good results). Since the increase in the potential energy of these powerful x-ray machines exposes the

This paper was illustrated with lantern slides.

patient to greater danger, the actual administration of this new form of therapy should be entrusted to men experienced both in the technical and clinical phase of the treatment. This new high powered machine has a maximum capacity of 250,000 volts and 5 M.A. The spark gap is approximately 20 inches. A .5 *c.m.* copper or zinc filter and a special Coolidge tube designed for high voltage are employed.

The dosage in tuberculosis must be a stimulating one and should be from 20 per cent. to 60 per cent. of skin erethema dose at the focus of disease. Large doses, instead of stimulating the formation of connective tissue about the diseased area, may produce destruction of the surrounding tissues, and consequent spreading of the disease. In the experimental stage which now has largely passed, many unfortunate results occurred through over-exposure either from too large single doses, or from too frequently repeated small doses. To avoid the accumulative effects of x-ray, Professor Schmieden advises that the interval between treatments should be at least six weeks.

The favorable action of radiotherapy in tuberculosis does not depend upon its raising resistance, nor upon its destructive action upon the tubercle bacillus, for it neither increases resistance nor destroys bacteria. It acts by stimulating the epitheleoid cells surrounding the diseased focus to increased proliferation, thus favoring connective tissue formation and producing encapsulation of the affected area.

Since x-ray treatment does not increase resistance and surgical tuberculosis is often only a local manifestation of a general disease, where resistance plays an important role, we feel that x-ray therapy will give better, more rapid and more permanent results if given in combination with heliotherapy and open air treatment. Professor Schmieden attributes his excellent results to the judicious combination of these measures, and also claims that this combination will shorten the time of the sun-cure treatment of surgical tuberculosis from one-third to one-half.

There is a great deal in common in the local effects of stimulating doses of x-ray and solar radiation. In both there is stimulation in the formation of connective tissue; absorption of fluid and abscesses and intense recalification of the affected bone. As in heliotherapy there is a preservation, and, in most cases of fibrous ankylosis, a return of function of the joint. These results are apparently obtained in a much shorter time with x-ray than with sun-cure.

It is the opinion of the German observers that while good results may be obtained in superficial tuberculosis lesions and small joints with the ordinarily 100,000 or 120,000 volt machine, the results in deep lesions and large joints have been disappointing because of the impracticability of applying dosage of even distribution with the less powerful x-ray equipment. Great stress is laid on the necessity of homogeneous doses, as it is by giving too much dosage to one part and not enough to the other, that poor results and, oftentimes, unfortunate ones, occur. This homogeneous depth dose can easily be arrived at by the use of Holfelder

special field selector. The use of the high voltage will also enable us to shorten the time of exposure.

In the brief time allowed us, we can present only a short summary of our results.

We have treated, in all, thirty cases of so-called surgical tuberculosis, the last of which were treated on April 21st. The latter group were radiated so recently, that we do not feel justified in offering any definite conclusions, although all of them, even in this short space of time, are showing definite clinical improvement.

Of the first group of twenty cases, nine received x-ray therapy on November 23, 1921, and November 25, 1921; three on January 11, and eight on March 13, of this year. Of those radiated in November, five were retreated in March.

The types of cases treated in the first group are as follows:

Cervical adenitis, four; bone, three; joints, seven; peritonitis, three; non-healing operation wound caused by the removal of a tuberculosis kidney, one; empyema, two.

We noted in all of our gland cases a reduction in the size of the nodes and in one absorption of the pus content of a non-ruptured gland, while in another we noted an increase that necessitated aspiration. The three bone cases showed a diminution in the swelling of the soft parts, disappearance of pain, lessening of drainage and the closing of a sinus in one that had resisted operative interference and sun-cure for one year. Radiograms show a beginning of recalcification by this treatment more quickly than has been observed with any other form of treatment. In one of the cases that was treated before admission to the hospital and that showed definite improvement under radiation, we got a specific history and found a positive Wassermann. We have stopped radiation in this case and are giving specific treatment. Whether this case is a combination of syphilis and tuberculosis or is purely a case of syphilis, we cannot say. There is no doubt of the improvement that took place under the deep x-ray therapy.

Six of the seven joint cases showed definite clinical improvement, such as relief from pain, increase in the painless range of motion, lessening of the swelling, and diminution in the amount of drainage. The radiograms show less blurring of the joint, better outline of the bones, and intense recalcification. The other joint case shows more fogging, but as this case was not under our direct observation between the time the radiograms were taken and the time the treatment was given, we do not know whether the joint got worse before the treatment or after. Our peritonitis cases showed marked improvement; swelling diminished, tenderness disappeared, and sinuses closed in one and are nearly healed in another. The case in whom the sinus healed soon after the treatment had resisted solar radiation for over nine months. The non-healing tuberculous wound was 3½ inches long, 2 inches wide, and 2 inches deep before radiation, and was healing slowly under sun treatment, but after radiation the healing was decidedly more rapid and now

the drainage is very slight and the wound itself almost closed. In our empyema cases we noted a diminution and liquefaction of the discharge in one, and an almost unbelievable recovery in the other. The latter case had one rib resected in 1918 and four more in 1919. She also had been operated upon six times to relieve systemic symptoms. She had had a profusely discharging fistula for nearly four years; she had received solar radiation and ultra-violet treatment and the application of the Posmeur Thazac lens with improvement in the physical condition, but none in the local. The fistula in this case healed on the fifth day after the treatment and after a period of about five months is still healed. The patient has been working steadily for the last four months and has gained an additional ten pounds.

In conclusion, we wish to impress upon you that any opinion we hold is in the formative stage, but we believe that observation encourages and warrants the continuation of the treatment, which we fully expect to use extensively as soon as our therapy building is completed and equipped.

The Chairman: The paper is open for discussion. If there is no discussion, five minutes may be used for showing plates. (*Plates were shown*)

Dr. Pryor: I have been asked if we have employed this treatment at all in tuberculosis of the lungs. My answer is that we have not, but it is being employed in Germany in this manner: The cases of the fibroid type are treated by freezing the phrenic nerve with ethyl chlorid and the diaphragms paralyzed thus producing a partial artificial pneumothorax; then the chest on that side is given deep x-ray therapy. They report much more rapid fibrotic change as the result. We have not tried this; we decided to be cautious, but we have now tested out twenty-five rabbits with the application of ethyl chlorid and the freezing of the phrenic nerve, and we find that in one minute the application of ethyl of chlorid will freeze the phrenic nerve on that side and it is paralysed for about thirty days after that. It is our intention to try this treatment in the fibrotic types of tuberculosis in the human being.

CHRONIC PULMONARY TUBERCULOSIS IN CHILDREN

By F. H. Hunt, M.D.

Boston

Chronic pulmonary tuberculosis in children is well described in many text books and monographs, but, as a rule the emphasis placed on bone, gland and other manifestations of the disease is so overwhelming, that to many of us the occurrence of lung chronicity, if not forgotten entirely, remains but a vague, indefinite or rare possibility.

Or, for example, when we refer particularly to pulmonary tuberculosis, all of us remember that Holt says, concerning the pathology of chronic pulmonary disease, as follows:

"In children who have passed the seventh and eighth year, the pathological process resembles that seen in adults; but, in younger children, and especially in infants, nothing corresponding to it is met with."

On the other hand, not all of us recall that under the heading "Clinical Forms," the same author writes of tuberculous bronchitis as follows:

"How many infants there are with such a form of tuberculosis, and how long such a condition may continue without definite signs developing, one can only conjecture, but the number of such cases is, we are convinced, not small. They form a very distinct but important group of tuberculous cases.

The regularity with which bacilli appear in the sputum indicates what a factor they may be in spreading disease. How many recover, and in how many the disease goes on to development of more serious lesions it is impossible to say."

In this paper I desire to lay particular stress upon lung chronicity in children, giving but little thought to the underlying pathological type of lesion.

In 1900, Nägeli's autopsy findings as to the occurrence of either healed or active tuberculous lesions in practically all of his material created quite a sensation and have been discussed, confirmed, accepted or denied even up to the present time.

Burkhardt's confirmation of Nageli's work is often quoted but no particular interest seems to have been attached to his statistics regarding lethal tuberculosis. He attempted in his subjects to discriminate between lethal, latent active and latent inactive lesions, and, distributed according to age, found two high mortality curves, one between 18 and 30, the other, slightly lower, between 5 and 14.

If his figures be correct, how may the discrepancy be explained, when mortality statistics, excluding the first two years of life, show that deaths from tuberculosis only begin to make an impression at about the twelfth year?

Are these cases signed out as dying from other causes, or have the children who die at 12 and over had chronic pulmonary tuberculosis for many years as in our adult group, or again, are Burkhardt's figures to be controverted and thrown out entirely?

I cannot help but feel that there is a great deal more chronic pulmonary tuberculosis in children than we are at present finding, children with positive sputum and definite lung sign and x-ray evidence, and who run a clinical course so closely paralleling our adults in exacerbations and remissions, in duration and in bodies of apparent health and of normal or near normal weights, that they have earned the title "adult type."

The Bulletin of the Department of Health, New York City, in 1915 published the following statistics. "Among children examined by Medical Inspectors during the school year 1914-1915 only 68 were found with clinical tuberculosis."

At the meeting of the Massachusetts Tuberculosis League, held in April of this year, statistics were presented showing that in the Boston Public Schools 28 cases of tuberculosis were found in 1918 as compared to 6 in 1921. This in spite of the fact that the school population had increased.

In the Framingham report of Dr. Armstrong in 1920, we find that out of a school population of 2500, there had been discovered in the first year 11 cases of pulmonary tuberculosis and 64 suspects previously unknown. The 11 were all cases of pulmonary tuberculosis, either active or inactive.

There seems to be no way of reconciling the first two reports with that of the Framingham Demonstration.

If we were to take only 5 cases as representing Framingham's 2500 children, and without considering the 64 suspects, that would give New York City over 1800 instead of 68, or more than 25 times the number found.

Which figures are we to accept? Those sent out from Framingham or those from New York City and Boston, always remembering that in both of these larger cities the quest after tuberculous children has for many years been an active one.

At the Boston Sanatorium one-third of our children are of the chronic type. It has been suggested that we get about all the cases of this class that are found in the city. We can't feel so optimistic for it is well to bear in mind that these chronic cases, early and sometimes late in their course, will positively not be found except by painstaking observation and until they are routinely examined by men fairly well qualified in chest work. If indications for these examinations are to depend upon the detection of symptoms by school nurses the problem will never be

solved, for we know that these symptoms are only too often far too vague and transitory, to be so easily discovered.

We also admit to our children's hospital observation, acute, cervical, and bronchial gland cases, and it seems to us that in general, it may be said of the clinical course of the several types, that the acute soon die, the observation and bronchial gland cases are seldom sick, requiring but little more than good food and air for their seeming recovery, while the chronic pulmonary cases live on for many years, well most of the time, for indefinite periods capable of going to school, will take part in all games and sports if not restricted, and usually are apparently as healthy and happy as their more fortunate companions and though, as time goes by they make their usual gain in weight and height, their lung lesions slowly but surely extend in spite of treatment, until finally they appear in the mortality columns years after the first noticeable parenchymatous involvement.

In the accompanying illustrations of chronic disease in children, an endeavor has been made, in some cases to compare and contrast fairly well nourished bodies with their chest plates, and in others to show the extension of the lesions, during which time the patients have most often made normal gains in weight and height. All of these children are positive sputum cases. All but one have persistent chest signs other than D'Espine's. Their average age at the present time is twelve years; average stay in hospital four and one-half years, with a previous minimal history average of one and one-half years. All are slowly progressive. Parental history is positive in three, probably or suspiciously so, in three and negative in two. They embrace five race stocks; three are Irish, and one each Jewish, German, Italian and Syrian. This about corresponds to the race proportions of our adult population. Six are normal or overweight at present or most of the time; two always under but have approached nomal at times. Their average height for age is over rather than under. Cough was the first noticeable symptom in three; cervical adenitis in two; phlyctenular conjunctivitis in one; loss of weight in one, and peritonitis in the other. Under treatment, pulse instability is much more outshanding than temperature reactions.

Night sweats are conspicuous by their absence. Sputum is consistently swallowed and obtained only by effort on the part of the physician. Cough is much less in evidence than in adults and the occurrence of inter-current affections are so frequent, so much more so than in other children, that we feel like suggesting that pulmonary lesions discovered during the convalescing period of many childhood diseases might oftentimes have been located many months before rather than at that particular time.

Case 1.—Is six and one-half years old, Syrian, mother died of pneumonia when patient was 18 months old. One month later the child had a phlyctenular conjunctivitis, then in order a pustular eczema, whooping cough, measles, chronic bronchitis, chicken pox, pneumonia, scarlet fever and finally pulmonary tuberculosis.

Was admitted in November 1919. At that time under-weight and with signs in left base.

In February 1920 had an acute exacerbation of the lobar pneumonic type; was placed on the dangerously ill list. Plate *1a* shows chest at this time. Temperature and pulse had settled down two months later and in the following five months she had gained ten pounds. For the next year her condition was stationary though gaining slightly in weight. The past fall her pulse rate began to rise, with occasional temperature to 100. She was very acutely sick for the first two months of this year. The plate *1b* was taken then. Since then she has had a severe peri-tonsillar abscess but has gained three pounds and while in bed is bright and lively and her one complaint is caused by not being allowed up.

Case 2.—Plate *2* was taken two years ago of a boy, then ten years old, of Irish stock, whose father died of tuberculosis. This boy has been a patient in our hospital for nearly seven years. When this plate was taken he was over-weight though the signs in his left chest had shown progression since his entrance in 1915. As early as 1917, typical cavity signs appeared in the left second and third interspaces towards the sternum which we thought we could demonstrate on stereoscopic plates. Our conscience here was never quite clear, however, and we sometimes spoke of possible broken bronchial glands.

The frank signs may have been caused by one of Barlow's mediastinal pneumothoraces. From the standpoint of physical signs, however, it remained one of our best cavity demonstration cases and the subsequent shelling out of the whole upper lobe seems to favor our view point. About one year ago after having successfully gone through five grades of our open air school, taught by regular public school teachers, his temperature began to rise and he has been exceedingly toxic and hopelessly ill for the past six months.

Plate 2 shows the almost final stage. He was too ill to photograph. This boy felt well enough to play base-ball surreptitiously in the summer of 1919, and while an example of the failure in our police duties it is also an excellent proof of just how well these youngsters feel. The ball game in question caused not more than a fleeting pulse increase and no temperature reaction.

Case 3.—Is 12 years old, of Irish parentage, mother died six years ago in child birth, but she had been "failing" two years before death.

Patient admitted one year ago, 15 per cent. under weight and gross involvement of entire left lung and slighter changes in the right. No history of previous acute illness. Attended school regularly in previous years. School physician referred her to a nutrition clinic on account of under-weight. Was weighed weekly for one month then sent to country for six weeks. Returned to school for six months and finally diagnosed tuberculous by our out-patient department.

It seems almost impossible to believe that so much disease can present itself in a child of this age without having caused her to become a voluntary bed patient at some time, but the history in this case is reliable.

Since her one year's residence in the hospital she has gained nine pounds, but her temperature and pulse respond to the slightest exercise. She complains only of being kept out of school.

Plates *3a* and *3b* show progress over one year's duration.

Case 4.—A boy 18, Jewish parentage, negative family history. Was admitted six years ago with a gross involvement of left lung and lesser right upper. Previous history of a productive cough six months prior to entrance and an haemoptysis two months before. Weighed 85 pounds on entrance; at present 165 pounds; is now nearly six feet tall and says he never felt so well. While he had no definite previous history other than recent cough and haemoptysis, he had had pneumonia in his fourth, sixth and ninth year.

He had been going to school up to June, 1916, a few weeks before his entrance here.

4a shows his present chest plate.

Case 5.—A boy 13 years old, parents unknown, was sent to us with a definite right apex eight years ago. He came from a home for destitute children and there was a history of a previous peritonitis and pneumonia.

The plate *5a* was taken three years ago and *5b* a month ago. He had had a sub-acute exacerbation for about three months before this last plate was taken; he had just gained ten pounds, and since has gained an additional ten and at present though two inches over-height for age, his weight is slightly above normal for height.

Case 6.—A cervical adenitis case, ten years of age, Italian, negative family history. Was first admitted in June, 1921, with draining neck glands of five years' duration, and slight apical signs. Ran away from us last October and returned March of this year. During his absence he had gained ten pounds, while his sputum, before negative, had become positive. Plates *6a* and *6b* shows the extending lesions. Physical signs have greatly increased in both apices and below the clavicles but we are unable to demonstrate the left middle involvement as seen in the plate.

Case 7.—At present eight and one-half years old, mother died in our hospital one month after this child was admitted as a baby nearly eight years ago. On entrance the baby was very much under weight; was wheezing and coughing and presented physical signs corresponding to Holt's tuberculous bronchitis. Her temperature was constantly elevated for ten months after admission but her weight increased to near normal during the first year's treatment. This child with positive sputum in her fourth and fifth years has never been entirely free from symptoms of some kind.

Fine moist râles have been present in her right chest since our earliest observations. They persist but vary from time to time as to degree of moisture and extent.

The left chest in this case also on physical examination is very indefinite and not noted on our charts.

7a. shows her latest plate.

Case 8.—A 15 year-old girl of German stock, admitted in 1918. Both mother and father died of tuberculosis. In her fourth year she had swollen glands on both sides of her neck, and was taken care of at one of our local homes for children. She coughed for one year and her tonsils were

removed about this time. Her aunt claims her sputum was positive in 1912. This we have been unable to verify. When she was admitted to the Boston Sanatorium she was then twelve pounds under weight with a slight cough.

Physical examination negative as to chest but x-rays showing some infiltration to the second zone. In the following eight months she had gained fourteen pounds, had no cough, and my examination at that time shows negative findings with a notation that she be discharged to school in the fall if suitable home conditions were found. Six weeks later she was coughing and her sputum found positive. It was positive again in 1920 and while at present and for a year past we have been unable to get any evidence of cough, expectoration, temperature, or malaise, the weight chart shows an actual loss of forty-one pounds. We are keeping her on for observation.

8a shows her present plate. In this case even D'Espine sign absent. I never hope to be able to diagnose or even suspect this type by a physical examination.

The object of my paper was to call attention to this chronic tuberculosis. At two years of age and under we have children dying of tuberculosis; up until the twelfth year we have very little mortality. The more I see of childhood disease, the more I see of chronic pulmonary tuberculosis extending all along the line, not bronchial gland tuberculosis, but an immense amount of this typical adult tuberculosis.

STUDIES ON THE RESPIRATORY ORGANS IN HEALTH AND DISEASE

VII. A CORRELATION OF SYMPTOMS, VITAL CAPACITY READINGS, PHYSICAL FINDINGS AND X-RAY FINDINGS IN 619 CASES EXAMINED FOR PULMONARY TUBERCULOSIS*

By J. A. Myers, Ph.D., M.D.

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Tables and graphic charts have been prepared from which one may quickly ascertain the vital capacity percentage of any given case when a few simple measurements are known. These tables and graphic charts were made according to the normal standards of Dreyer, West, and Myers. They have been used in the study of more than 3000 apparently healthy men and women of Minnesota. The figures appear to be slightly low for the men and slightly high for the women of Minnesota. These tables and charts have been used also in the study of more than 600 individuals examined for pulmonary tuberculosis. It is true that normal vital capacity standards vary for people of different countries. It appears at the present time also that such standards vary for people of different sections of this country just as the normal height and weight standards for children of certain eastern cities are not correct for children of certain cities of the middle west. In the present study it makes very little difference what normal standards are used as long as all cases are compared with the same standards and due consideration is given to the fact that these standards may be slightly high or slightly low. For example, if one takes readings on a sufficiently large number of individuals in any given locality and finds the average vital capacity percentage is 105 one may regard this as normal for the people of that particular locality. Then if a group of individuals in the same locality is found to have an average vital capacity of 90 to 95 per cent. they may be looked upon as slightly abnormal for that locality.

*From the Department of Internal Medicine, University of Minnesota, and the Department of Tuberculosis, Minneapolis General Hospital.

Read by title.

In the present work an attempt has been made to correlate the symptoms, vital capacity readings, physical findings and x-ray findings in a group of cases examined for pulmonary tuberculosis. The 619 cases included in this paper came for examination because pulmonary tuberculosis was known to be present or was believed to exist. Stereoscopic

TABLE I

Cases Grouped According to X-ray Findings

	Number of cases	Vital Capacity Percentage			Cases in Sanatoria per cent.
		Average	Lowest	Highest	
Negative	89	103.4	82.0	122.0	
Probably chronic bronchitis	24	107.8	82.0	128.0	
Peribronchial infiltration	102	103.3	74.0	133.0	
Old pleurisy, no pulmonary tuberculosis	23	91.0	64.0	118.0	
Parenchymatous lesions					
A. Unilateral					
1. Above the first rib	98	98.7	70.0	120.0	23.4
2. Not more than one lobe	46	92.4	31.0	122.0	60.8
3. More than one lobe	18	68.0	38.0	120.0	66.6
B. Bilateral					
1. Above the first rib	38	91.8	51.0	110.0	26.3
2. Not more than two lobes	53	79.0	43.0	119.0	73.5
3. More than two lobes	25	54.0	26.0	82.0	80.0
Total number of cases	516				

x-ray plates were made in 516 of these cases. Table 1 shows the patients grouped according to the x-ray findings. In 89 cases in whom the x-ray findings were entirely negative the average vital capacity was found to be 103.4 per cent. In 24 cases whose x-ray plates suggested chronic bronchitis the average vital capacity was 107.8 per cent. One hundred and two patients with peribronchial infiltration had an average vital capacity

of 103.3 per cent. This is approximately the same percentage as was found in the cases with negative x-ray findings. There are 23 cases whose x-ray examination revealed old pleurisy. Some of these patients gave histories of pneumonia and empyema, but none of them had demonstrable pulmonary tuberculosis lesions at the time of the examination. These cases had an average vital capacity of 91 per cent.

The patients whose x-ray examinations revealed parenchymatous infiltrations were divided into two classes as follows: A, those with unilateral disease; and B, those with bilateral disease. The cases with unilateral lesions were grouped according to the extent of the disease as follows: (1) those with disease above the first rib or an area of similar size in some other part of the lung; (2) those with disease involving no more than one lobe; (3) those with disease involving more than one lobe. There are 98 cases in the first group with an average vital capacity of 98.7 per cent. This average percentage seems high, but there is a considerable number of these cases who have slight fibroid or calcified lesions of no clinical significance. In the second group there are 46 cases with an average vital capacity of 92.4 per cent. The 18 cases in the third group show an average vital capacity of 68.0 per cent.

TABLE 2

Cases Grouped According to Physical Signs and Symptoms

	Number of cases	Vital Capacity Percentage		
		Average	Lowest	Highest
Negative	149	103.6	84.0	132.0
Diagnosis reserved	21	104.9	81.0	115.0
Chronic bronchitis	100	103.8	69.0	133.0
Pleurisy	29	92.4	63.0	118.0
Parenchymatous Involvement				
1. Minimal				
a)	99	96.2	71.0	122.0
b)	25	79.4	58.0	89.0
c)	5	77.6	57.0	103.0
2. Moderately Advanced				
a)	44	86.2	65.0	120.0
b)	66	68.5	31.0	103.0
c)	12	49.2	25.0	61.0
3. Far Advanced				
a)	17	54.8	32.0	80.0
b)	41	50.5	33.0	83.0
c)	11	39.6	26.0	61.0
Total number of cases	619			

The cases whose x-ray examinations revealed bilateral disease were grouped as follows: (1) those with disease above the first rib, or an area of similiar size on each side; (2) those with disease involving no more than two lobes; (3) those with disease involving more than two lobes. In the first group there are 38 cases with an average vital capacity of 91.8 per cent. In the second group there are 53 cases with an average vital capacity of 79.0 per cent. There are 25 cases in the third group with an average vital capacity of 54.0 per cent.

In all the groups of cases with parenchymal lesions it will be seen that the vital capacity percentage range is quite wide. Most of the low percentages are explainable on the basis of active pulmonary disease. The high percentages may be due to the facts that an over-developed vital capacity existed prior to the development of disease, or the present lesions revealed by the x-ray are of slight or no clinical significance.

It is interesting to note that 23.4 per cent. of the cases with unilateral disease above the first rib are in sanatoria while only 26.3 per cent. with bilateral disease above the first rib are in sanatoria. The percentage of cases in sanatoria becomes materially increased as the extent of disease revealed by the x-ray is increased.

When the cases were grouped according to physical signs and symptoms it was found that there was no evidence of disease revealed by physical signs in 149 cases. The average vital capacity of these cases is 103.6 per cent. There are 21 cases in whom the diagnosis was reserved because of questionable physical signs and symptoms. The average vital capacity of these cases is 104.9 per cent. The 100 cases with definite evidence of chronic bronchitis show an average vital capacity of 103.8 per cent. The lowest vital capacity reading taken in this group is 69.0 per cent. In this and a few other cases with rather low vital capacities the expectoration was profuse and the low reading may be due to mucous obstruction of some of the bronchial tubes. Twenty-nine cases with pleurisy show a vital capacity reduced to 92.4 per cent.

The patients whose physical examination revealed evidence of parenchymatous involvement were grouped into the minimal, moderately advanced, and far advanced stages. The patients in each stage were then sub-grouped according to whether they had (a), (b), or (c) symptoms. The 99 cases with minimal (a) tuberculosis show an average vital capacity of 96.2 per cent. There are 25 cases with minimal (b) disease whose average vital capacity is 79.4 per cent. The average vital capacity was found to be 77.6 per cent. in 5 cases with minimal (c) disease.

There are 112 cases with moderately advanced disease. Forty-four of these cases with (a) symptoms show an average vital capacity of 86.2 per cent., 66 cases with (b) symptoms an average vital capacity of 68.5 per cent. while 12 cases with (c) symptoms have an average capacity of 49.2 per cent.

There are 69 cases with far advanced disease. Seventeen of these cases with (a) symptoms show an average vital capacity of 54.8 per cent. Forty-one cases with (b) symptoms show an average vital capacity

of 50.5 per cent., while 11 cases with (c) symptoms have an average vital capacity of 39.6 per cent. Thus it may be seen from table 2 that the average vital capacity for each stage of the disease decreases as the symptoms increase.

SUMMARY

1. This study includes 619 cases who were examined for pulmonary tuberculosis.

2. Stereoscopic x-ray plates were taken in 516 cases while physical examinations were made in 619 cases.

3. In 149 cases in whom the physical examination revealed no evidence of disease, and 89 cases in whom x-ray revealed no evidence of disease, the average vital capacity was found to be approximately 103.0 per cent.

4. In 100 cases suffering from chronic bronchitis the average vital capacity was slightly higher than 103.0 per cent.

5. Twenty-nine cases with pleurisy showed an average vital capacity reduced to approximately 92.0 per cent.

6. All groups of cases with evidence of parenchymatous lesions showed reduction in the average vital capacity. The average vital capacity was found to decrease with the extent of disease revealed by the x-ray and physical signs. There was also a decrease in the average vital capacity with increase of symptoms.

NOTE: I am deeply indebted to the Hennepin County Tuberculosis Association (Minneapolis) for financial aid received in the preparation of this paper.

PERMANENT EFFECTS OF GAS IN WARFARE

By John L. Hankins, M.D., and Walter C. Klotz, M.D.

Johnson City, Tenn.

The significant features in connection with ultimate effects of gas in warfare are, 1, the possible relation to permanent functional impairment and vocational handicap; 2, the etiological relation to later manifestations of tuberculosis, and 3, the differentiation of tuberculosis manifestations from those produced by gas. In order not to confuse the issue, however, only the first point, namely the one of functional impairment has been considered in this study, for the reason that it seemed the most important in practical significance.

Before proceeding to an analysis of our own cases it may be of interest to recall briefly the findings noted by other observers more recently after the war. Special reference is made here to the work of Winternitz and his findings in experiments on animals[1]. The changes noted in these experiments were the same as those that had been found on necropsies of human subjects and consisted of a thickening of the mucus membrane of the respiratory passages from the trachea to the finest bronchioles, extending even to the alveolar passages, with organization of the proliferated tissues. This inflammatory process would lead to stenosis or partial obliteration of the air passages, resulting in emphysema or atalectasis. Now that more than three years have elapsed since these effects were originally produced, it seemed of interest to determine to what degree they have persisted and of still greater interest to determine to what degree they might remain permanently.

For the purpose of this study 166 cases were selected from among 3887 patients treated at the Johnson City National Sanatorium, who gave a very definite history of having been gassed during their military service, and who moreover had been hospitalized on account of gas effects. In none of these patients had the period of hospitalization on account of gas been less than twenty days, while in some of them it had extended over three months. This point was emphasized in order to exclude such patients who might have had only slight effects as a result of gas, and in whom, therefore, marked anatomical effects would not be expected. Many former service men if simply asked the question as to whether they had been "gassed," might answer in the affirmative, even if the exposure might have been insufficient to produce any serious or harmful results. Attempts were made at first to group these patients according to the kind of gas to which they had been exposed, but it was realized that any information of this kind was apt to be misleading. Many stated that they had been exposed to different kinds of gas, and it is known that this was a deliberate procedure in gas warfare after the use of gas shells had been generally introduced.

These cases were studied from the point of view of history; clinical symptoms before and during the period of observation; the physical examination of the chest at different periods and finally by noting carefully the x-ray findings. As none of these patients died, autopsy findings are not available. It is realized that compared with the many ex-service men hospitalized, the number of cases studied is too small to warrant any definite conclusions. For that reason the results of this study are submitted merely as a preliminary report, with the hope that they may stimulate further research among the very extensive material offered by the many patients with chest conditions now undergoing treatment in government hospitals. By analyzing the observations of numerous workers and combining such results it may be possible to determine the true status of this very important question which may have important economic as well as clinical significance.

Out of the 166 cases in our series, 66 per cent. were diagnosed as clinically tuberculous. Only one case gave a positive sputum examination. None of them were advanced cases of tuberculosis. In 25 per cent. the x-ray findings were those usually accepted as indicating active tuberculosis. About 25 per cent. gave a history of influenza or pneumonia. All of these patients not only stated that they had been hospitalized on account of the effects of gas, but maintained also that they had never recovered their health since. They complained of being easily fatigued; that they were unable to perform their accustomed duties; that they lacked energy and were no longer able to sustain physical effort. The later symptoms complained of, that is during the period of observation, were fatigue, and especially shortness of breath. Cough and expectoration were particularly marked in the morning and were frequently aggravated by atmospheric conditions, such as dampness, rain or fogs. In a number of them, marked asthma symptoms were present and the patients in question, insisted that such asthmatic attacks had not occurred previous to their military service. The symptoms described above were present to an equal degree, whether they had had influenza or not; nor were they influenced apparently by the degree of tuberculosis activity. None of them were in the advanced stage of tuberculosis, as was noted above, and in all of them the functional symptoms were entirely out of proportion to the amount of tuberculous activity or involvement.

The physical signs noted in this group of cases were quite constant and characteristic. There was a general lack of expansion, with an irregular inspiratory excursion and an impression of stiffness of the thorax. More commonly there was dullness over the base and mid zones of the lungs, with distant breathing. Over the upper lobes, breathing was usually more harsh, sonorous, bronchovesicular in character. Sibilant and sonorous râles were heard over the upper lobes in front and behind in a small number of the cases. In these instances where active tuberculosis coexisted the signs were those usually met with, both as to character and distribution. There was no difficulty in distinguishing the two

processes where they were present simultaneously. There seemed to be a definite line of demarkation. The picture was not at all that of chronic fibroid tuberculosis as encountered frequently in the older adult type. All of these patients were naturally young adults of military age. In addition to the signs referable to the lungs themselves, a certain number showed enlargement of the heart, as noted more particularly in connection with the x-ray findings described below.

The findings obtained by means of x-ray examination were by all means the most interesting and striking. Fluorscopic observation disclosed a very jerky, retarded inspiration and the same stiffness of the chest that was noted in connection with the physical examination. Stereoscopic radiographic plates showed distinct, hard, clear bronchial markings, sharply defined, not extending to the periphery and not beaded. These markings were not confined to the upper portions of the lungs, but on the contrary distributed over the middle and lower thirds. The pleura frequently showed the ground glass haziness characteristic of chronic thickening. Cardiac enlargement involving the right heart was noted in 30 per cent. This condition or change of the heart is one that one would naturally expect as a result of pulmonary fibrosis and impeding of the pulmonary circulation.

The clinical picture in these patients was that of a chronic peribronchitis, occurring in young adults, resulting from a permanent thickening of the bronchial mucus membrane. This thickening is due to the inflammatory proliferation following the necrotic effects of irritating gases. These changes correspond with those noted by Winternitz referred to above and have been noted by other workers. In so far as these changes still persist at this period, and as moreover similar changes produced by other causes are usually considered permanent, it would seem probable that these changes produced by gas in warfare will also be permanent. How much of a vocational handicap results from these permanent effects is a matter for serious consideration. In fact the question is such a serious one that it cannot be disposed of lightly, nor without further study and observation. It would seem to be established, however, that such a form of chronic gas bronchitis does handicap its victims and places them in a position of higher age rating.

Summing up therefore:—

A series of cases was selected from those who gave a definite history of having been gassed to a serious degree.

All of the cases in this series disclosed a definite and constant clinical picture of chronic bronchitis of varying degree of severity, with or without accompanying emphysema.

In view of its present duration and persistent pathological changes, this form of bronchitis promises to be permanent and to produce distinct functional impairment.

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TUBERCULOSIS AND POISON GAS

By A. P. Francine, A.M., M.D.

Harrisburg, Pa.

The experience on which my opinions are based consists of four months' service as Consultant in Gas to the Fourth Army Corps in the St. Mihiel and Argonne sectors, six weeks of which was spent as resident physician-in-chief to the great gas hospital at Toul. It therefore, concerns only the effect of gas as I saw it on American troops at a time when gas discipline was generally good and our type of gas mask effective.

The only gas which I will consider is mustard gas, because that was used almost exclusively and had become recognized as the most effective of all battle gasses in producing casualties.

It should be understood that so-called mustard gas is not what many people would consider a gas at all, but is a heavy oil thrown in shells. Great extent of terrain can be contaminated for long periods of time, as long as ten days to two weeks, particularly in damp, wet, low-lying fields or woods. It volatizes with difficulty and only under warm sunshine. When it volatizes it is detectable by odor, otherwise not. Any troops going into such areas or sleeping there are burned (gassed). It is usually not inhaled at all. Its action is escharotic, like ivy poisoning. Burns take some time to appear, often twenty-four hours.

So that when I think of the hundreds of men littered into the hospital every night or so, I do not picture men who were coughing, choking or gasping for breath, for they were not; they were cold, exhausted, quiet men, burned more or less severely about the eyes and body. Approximately 80 per cent. of our cases were suffering from mustard gas. Seventy-five per cent. of these were not severely gassed, and of this number 20 per cent. were probably not gassed at all but were victims of exhaustion, shell-fume, etc.*

Other types of gas like phosgene and chlorine are vastly more deadly but are effective only in such high concentrations, hence in such a restricted area, that they are very ineffective as compared with mustard gas. It is vastly more important to put two hundred men permanently out of the lines (only slightly injured though they may be), than to kill five men outright.

*Report for hospital kindly furnished by Major A. G. Love, M.C., U. S. A. Exact statistics are not available for a number of reasons, the uncertain hour and hurried nature of admissions and evacuations, lack of personnel, etc.

That is one reason why gas is infinitely more humane than shot and shell. In only about twenty per cent. of admissions was the condition severe enough to confine the men to bed for more than forty-eight hours.

Diagnosis was usually evident on admission, though 191 cases were classified (erroneously, I believe) as due to phosgene. None of these cases showed pulmonary complications, except a few râles which soon disappeared. None died.

Treatment was simple, carried on by medical officers, nurses, orderlies and convalescent comrades. I was particularly interested in studying the chests of these men and went over hundreds of them with care. In the great majority there were no clinical findings whatever. In some there were râles; apparently from the history, the result of an already existing bronchitis. These usually cleared up after a day or two of rest in the hospital. The same is true of coryza. A few whose lungs were clear on admission developed influenza or bronchitis, which appeared, possibly, as a result of cross infection, so beds were cubicled to prevent this.

Except in relatively few cases, I could attribute no possible relationship, and at no time anything of a permanently damaging nature to the lungs from gas. In other words they had not inhaled the fumes, or had inhaled them very slightly. There was little more in these chests than one would encounter in any general medical ward, and not as much as one would find in a clinic devoted to diseases of the chest. There was no active tuberculosis noted. No tubercle bacilli were found in those who had expectoration, not even in the few who had râles and for some days blood-streaked sputum.

The percentage of deaths in the gas hospital was 1.98 per cent. All the deaths were from mustard gas. This percentage again goes to show that the mortality and effects of gas have been, as was to be expected, greatly exaggerated and misunderstood in the minds of laymen, soldiers, and doctors, who did not study it closely and among large groups. This is to be understood as relating to the later months of the war, when gas defense had become well developed.

Some died directly from prolonged inhalation of the gas, or from inhaling it greatly concentrated. At autopsy the bronchial tubes were found seared as with a red hot iron and the lungs were bloody sponges. It might be argued that sufficient time had not elapsed for the lighting up of a tuberculous process. However, death occurred among a number of men who were badly burned about the body, who had inhaled gas, and who had been in the hospital from five to seven weeks. They were sick, very weak, but improving; and each case died from an intercurrent infection such as myocardial insufficiency (asthenia), nephritis, or from acute influenza (bronchopneumonic). No evidence of reactivation of existing tuberculous lesions was found in these cases.

The skin burns healed rapidly and these men were evacuated to base hospitals usually in from four to seven days. Their chests were carefully examined before evacuation and their lungs were clear, or there

was only a mild bronchitis, in practically all instances. Some who were very slightly gassed and in good physical shape were returned after a few days' rest to their organizations in the line.

I believe, however, that there was a certain mental shock from having experienced in even a slight degree, a touch so to speak, of this little known and dreaded gas. This I know to have been the case in the production of aphonia in certain cases, purely neurotic in origin, which have yielded to appropriate treatment. There may have been other resultant effects with which I am not familiar, but certainly none of a pulmonary character. It seems true, however, that a man who has once been gassed has come to attribute, (whether sincerely, or through ignorance) any illness, pain in the chest, shortness of breath, acute bronchitis, or tuberculosis, to his gassing.

A number of such cases which I have personally examined were found never to have been gassed at all. In some instances they were taken for a night to one of the advanced triages, or field gas hospitals for observation, and returned to the lines without evacuation. They had never passed through the evacuation gas hospital of the Justice Group (Toul) as they would have had to do had they been really gassed.

That gas, as I saw it, from the point of view of one who had had considerable preliminary experience in conditions of the chest, could leave any damaging effects, not only on the lungs, but elsewhere, is inconceivable. There may be a neurotic element akin to, but not so evident, as so-called shell-shock, but I should doubt it as the injuries were usually so slight.

I have attempted to give you only my personal impressions mellowed by medical experience in civil life. Brigadier-General Amos A. Fries, Chief of the Chemical Warfare Service, has dealt with this subject in a masterly and interesting way, as has Colonel H. L. Gilchrist and Colonel James Robb Church. Let me quote from a paper by General Fries:

> "According to the report of the Surgeon General, U. S. Army, for 1920, 258,338 men were injured during the war. Of these 34,249 died on the field of battle and 13,691 died in hospitals. There were admitted to the hospitals (this does not include marines) 224,089. Of this number, 70,552, or 27.3 per cent, were suffering from gas alone. Of the 70,552 gas cases, only 1,221 died. Of the 153,537 admitted to the hospitals suffering from bullets, high explosives, and other methods of war except gas, 12,470 died. Of those killed on the field of battle, we know that very few—probably under 200—were from gas, since concentrations of gas sufficient to kill within say twelve hours were seldom obtained. If we assume that 200 died from gas on the field of battle, the total deaths from gas would be 1,441 out of 70,752, or less than two per cent. In like manner, of the 187,586 injured by bullets, high explosives and similar methods, 46,449, or more than 24 per cent. died. Thus it is evident that the man who was injured by gas alone on the field of battle had twelve times as many chances for recovery as the man wounded with bullets and high explosives."
>
> "Other comparisons are still more striking. On page 21 of that report we are told that 86 men were totally blinded in the war, 44 were partially

blinded in both eyes, and 644 were blinded in one eye. These include eyes destroyed or those in which the sight was lost. Of the gassed patients, it is stated that four were blinded in both eyes and 25 in one eye, a total of 29. These 29 were 3.85 per cent of all those suffering blindness in one or both eyes. In other words, bullets, high explosives, and other methods of warfare than gas were responsible for 25 times as many blinded as was gas."

Conclusions from my experience during the last four months of the war, when there was very intense use of gas, are as follows:

1. The terrible impression people have of gas arises from its early, tragic, inhuman, and indefensible use against troops, surprised and defenseless before this untried but potent offensive weapon.

2. People generally, including the rank and file of Army men, have a much distorted mental picture of its effects, and begin by thinking of it as of the nature of deadly fumes. Generally speaking it is nothing of the sort. The effects of gassing (mustard) are in the great majority of cases superficial eye and body burns.

3. Mustard gas is the most effective of all battle gasses in being the greatest casualty producer, and hence was by far the most widely used. It is not usually inhaled. It is a burn.

4. The percentage of death from gas was both absolutely and relatively extremely low; and the percentage of permanent disability (blindness) negligible.

5. Poison gas put more men out of action with less hurt to the individual than any branch of the service.

6. Following the perfection of methods of defence against it, it became many times more humane than shot and shell as proven statistically above.

7. Anyone who saw closely the use and effect of gas would far rather be exposed to a gas attack than take a chance with a half inch of red hot flying steel.

8. One might even be excused for characterizing it as benign to the extent that it put so many of our boys (nearly 70,000) out of the war with usually slight and temporary injuries, who would otherwise have continued to be exposed to the damaging effects, severity, and cruelty of gunfire. Of course, it may be objected that the lines were kept filled by replacements, and while measureably true, yet gas at least saved these particular gassed men.

9. It would appear incapable of leaving any pathological after-effects. It is inconceivable that gas (as it is, and not what so many people consider it to be, or what it may have been) could reactivate tuberculosis, and available statistics and majority expert opinion, go to prove that it does not do so. This view is endorsed by French, British and other authorities.

The Chairman: Brigadier-General Amos A. Fries, Chief of the Chemical Warfare Division of the United States Army, has been good

enough to come down to open the discussion for us. Brigadier-General Fries.

DISCUSSION ON PAPERS BY DR. HANKINS AND DR. KLOTZ AND BY DR. FRANCINE

Brig.-Gen. Amos A. Fries, Washington, D. C.: Civilization is today so complex that no organization or business can operate distinct from all others. Everywhere we find men taking part in work that appears radically different from that for which they were trained. Thus, we have a doctor at the head of the postal service of the United States. To the average person, the only thing in common between the medical profession and the Post Office Department is that the one uses paper for letters and the other for wrapping pills. The work of the Chemical Warfare Service from the very beginning has been so closely in touch with the Medical Service that no apology is needed for my appearance here.

My knowledge of medicine is of the general order of knowing that castor oil is perfectly vile to take, or as my small boy once expressed it, "All medicines that are good for you seem to be the worst-tasting things in the world."

The subject of warfare gasses is of particular importance just at this time when the stage is all set to credit to those gases all tuberculosis cases appearing among ex-soldiers whether they were ever subjected to gases or not. Gas warfare was introduced as a weapon in the World War in violation of treaties that gases would not be so used. It was introduced at a time when the value of propaganda was just being realized. Furthermore, the effect of gases on people without protection is as deadly as the effect of machine gun bullets upon the naked bodies of savages armed with bows and arrows at short range.

It was good policy, as well as good propaganda, to make out that our enemies in the war were using a horrible and diabolical method of waging war. The same outcry against new weapons has arisen probably with every invention of a new weapon. But, as the medical profession well knows, this outcry is not limited to the profession of arms.

It is exceedingly difficult today to combat the prejudices excited by the wild days of propaganda and falsehood for political purposes that grew out of the World War! One of the charges made was that gas caused tuberculosis. Gas being new, battle scene writers, desiring to create a sensation, made use of every adjective possible to describe the horrors and terrors of gassing. No wonder the man who was gassed, as well as the man who wasn't, but who suffered from ills that he could not quite account for, found it easier and ever easier to lay his troubles to gas. Even the medical man, due to a complete lack of knowledge of the subject, was often forced against his will to admit the possibility that gas might do some of the things it was charged with, even when he could find no definite symptoms to that effect.

The influence of the mind has been well recognized by the medical profession for half a century. It can readily understand then that many a soldier has unquestionably made himself ill and perhaps become a prey to tuberculosis by the constant fear that sooner or later he was going to contract it, though he may only have had a sniff of gas, or perhaps only thought he did.

The medical profession early began a study in the use of warfare gases to see what the after effects were. The British in particular started this study at an early date. By the time the United States had entered the World War, British medical men in intimate touch with these gases felt that there would be no serious after effects in the vast majority of cases This is somewhat remarkable when we realize that the English received the first heavy gas attacks without protection and that they had in those days a terrific death rate running from 24 per cent. to 35 per cent. or more in the first gas attack.

Nevertheless, the idea that warfare gases cause tuberculosis and a host of other respiratory diseases still persists. It has opened up to the malingerer or the fraud who served overseas a chance to claim complete disability and thereby get the great benefits the United States has wisely and considerately given to its seriously crippled veterans. This is a phase of warfare gases that we of the Chemical Warfare Service and the medical profession generally must resolutely face. We owe it not only as a duty to the Government which we all serve, whether in public or private life, but also to those disabled veterans who deserve our every care.

The more fraud that is perpetrated, the greater the burden of taxes on the United States and the greater the tendency will be as time rolls on to refuse adequate aid to those who deserve it. The veterans' organizations themselves should be equally ready with the Chemical Warfare Service and the medical profession to ferret out and drive out impostors. We do not believe that the number of impostors at present is very great, but unless we make it definitely known that every case claiming gassing as a cause of disability will be tried out on its merits, the doors of fraud will become more and more congested by those who feel that claims of gassing are an easy road to a lazy life.

As indicated previously, there are thousands of veterans who are not enjoying the best of health, and not knowing the cause of their troubles are wondering if they were not gassed and if gas be not the cause of their trouble. That great numbers are feeling this way is indicated by the fact that while 70,552 were admitted to hospitals suffering from warfare gases during the World War, the number that apply for War Risk benefits, claiming gassing as the cause, is far above that number.

In checking up 1,056 applications for War Risk benefits taken at random from among those in Maryland, Virginia and West Virginia, 34 per cent. claim their troubles were due to having been gassed. Inasmuch as nearly 1,000,000 applications for War Risk benefits have been made, it is apparent that if this percentage holds true all over the United States, and there is no reason to believe it does not, already over 300,000, or

more than four times as many as were actually gassed, are claiming to have been injured by gas. Of the 365 cases who claimed they had been gassed, careful investigation indicates that 103, or about 30 per cent., were not gassed at all.

Many claim they were not severely enough gassed to apply for medical attention, and that the serious effects did not appear until many months, or in some cases, years, afterwards. This does not seem possible. Particularly do I feel that way about it when those in whom I have the utmost confidence, who have made the medical profession the work of their lives, and who have studied these cases by the wholesale, agree that where a long time has elapsed after an apparent gassing, there isn't a chance in a hundred that gas was the real cause of the trouble.

I am particularly glad to appear before a body made up of the civilian medical men of the country. You must support the medical profession of the Army in getting at the truth in this matter. Insistence by the Medical Officer or the Chemical Warfare Service Officer that gassing causes very few ills puts those officers in a difficult position with the veteran. Already too many charges are made that the veterans do not receive proper consideration, and that the Government officials are trying to beat them out of what is their due. I protest that no man is more desirous of having the injured veteran get every aid the Government can afford than is the Army officer—medical or otherwise. But just as we in the Regulars cannot shirk the responsibility of pointing out errors and frauds, just so must you in the medical profession back us up when we can show we are correct.

It is regretted that time will not permit going into this subject more fully, but from the information obtained during the war and through fifteen months of intensive investigation by Lieut. Colonel Gilchrist, Medical Corps, U. S. Army, Director of the Medical Section of the Chemical Warfare Service, I am convinced that no serious tuberculosis after effects can be attributed to warfare gases, and furthermore that the number of cases suffering any other serious after effects from warfare gases is small.

It is well to state here that the death rate from all forms of warfare, excepting gas, was over 24 per cent. while the death rate from gas was but 2 per cent. Furthermore, the permanently injured, including the serious and the very slight, was about 5 per cent. additional. If we apply these percentages to the gassed cases, we will find that had the 70,552 who were admitted to the hospitals suffering from gas been suffering from other wound producing materials than gas, we would have buried 15,500 more boys in France, and would have some 5,000 additional cripples of varying degrees. Certainly the after effects of gas are but a small fraction of these numbers.

It was realized by the United States soon after the close of the war that the condition now confronting us by the claims for injuries due to warfare gases might arise. Accordingly, a board of medical officers known as the Warfare Gas Board, was convened at Fort Grant, Illinois. All discharged soldiers claiming any disability due to the after effects of

gas were referred to this board. During their session, the Board examined collectively and individually over 2,000 cases and as a result arrived at the following conclusions:

1. That gas victims irrespective of the type of gas and severity of attack sustained, showed no marked predisposition toward active pulmonary tuberculosis, or toward reactivation of a healed or quiescent pulmonary lesion.

2. That gas victims presented little evidence of material destruction of lung tissues.

The report of the Surgeon General of the Army for 1920 shows that in the year 1918 there were one and one-half times as many cases of tuberculosis per 1,000 among all troops in France as there were among those gassed, and that in 1919 there were one and three-quarters times as many tuberculosis cases per thousand among all troops as there were among the gassed. This means that if gassing was not an actual deterrent to tuberculosis, it certainly did not aid in its development.

A report of the progress of the investigation conducted by the Chemical Warfare Service into this subject, covering the past fourteen months, is available and can be had upon application. Every effort has been made to obtain the views of other nations who took part in the World War. The foreign information received may be stated briefly to be as follows:

British: "The relation between tuberculosis and gassing does not develop more frequently in gas victims than in other subjects."

French: "Judging from experience, it does not appear that lung lesions caused by gas predispose to tuberculosis."

German: "The German physicians, both those who are in the service at the present time and those who were in the service during the war and who are now engaged in private practice or Government work, are practically unanimous in agreeing that there is no connection between warfare gassing and tuberculosis."

Swiss: "Professor Stachlin searched through the records of all chronic diseases occurring among prisoners of war interned, many of whom had been severely gassed. With but few exceptions he could find none suffering from the after effects of gas poisoning."

Let us look at this subject in another light. There is a terribly serious side to the charge that gas causes tuberculosis that has not yet been brought out. The records show conclusively that gas does not cause tuberculosis, but careless or ignorant people go right on repeating the charge, never thinking of the brutal suffering that charge may cause. Over 69,000 American boys now living were gassed more or less seriously in France. Another 500,000 were around gas at one time or another. What dark despair would haunt those men if the charge that gas caused tuberculosis were true?

Every man who talks about the inhumanity of gas and couples it with tuberculosis forgets the terror, the despair that he may cause hundreds and perhaps thousands of brave boys who went over the top. Gas no more causes tuberculosis than do bullets and high explosives nor than

does influenza, bronchitis, measles, whooping cough, or a hundred and one other diseases and wounds. Then let us not frighten every one of the boys who was gassed, or thinks he was gassed, by the belief that he is going to die of tuberculosis. Let us have this charge stopped and give the boys who fought a chance, remembering that the man who thinks he is ill is in a fair way to become so.

THE AFTER-HISTORY OF NINE HUNDRED AND FIFTY-THREE TUBERCULOUS PATIENTS DISCHARGED FROM THE METROPOLITAN LIFE SANATORIUM FROM 1914 TO 1920

By Horace J. Howk, M.D., Louis I. Dublin, Ph.D. and Inger A. Knudsen

This is the first of a series of reports we hope to make on the experience of the tuberculous graduates of the Metropolitan Life Insurance Company Sanatorium at Mt. McGregor. It is a preliminary statement on about one thousand such graduates, covering the period from the opening date, November 24, 1913, to December 31, 1920. That gives all the cases at least one full year of observation following discharge and the earliest cases as many as seven full years since discharge. While we realize that the period under observation is very short the material justifies treatment in view of certain favorable features. These consist of the homogeneous character of the population from the point of view of their uniform employment, their fairly good social and economic status and the high level of their intelligence. All of these items, of course, play an important part in the success of any sanatorium effort. The present study will show the effect of a rather ambitious attempt to serve these persons in every reasonable way, having in mind the unusual opportunities which were presented at the sanatorium.

The Mt. McGregor Sanatorium was built as the result of the determination of the officers and directors to care for the sick tuberculous employees of the Company. When this decision was made there were close to 18,000 employees in the Home Office and in the Field. Estimating the probable number of cases of tuberculosis needing treatment at 1 per cent. of the entire force, there was need for an institution containing about 180 beds and this was the number called for by the original plan of the institution. Since that time with the increase in the number of employees the original estimates have been correspondingly developed, and there is now available a total of 214 beds for tuberculous patients. The total number of tuberculous patients admitted to the Sanatorium from the beginning to December 31, 1921, is 1349. The following figures show the number for each year.

Total	1921	1920	1919	1918	1917	1916	1915	1914
1349	130	160	187	146	218	223	157	128

Of this number 18 were classed as suspected tuberculosis and 12 were non-pulmonary cases. This leaves a residue of 1319 pulmonary cases. Of this number 56 per cent. were admitted "incipient," 37 per cent. "moderately advanced" and close to 7 per cent. "far advanced." This may be compared with 1892 admissions to the Trudeau Sanatorium from 1911 to 1920, which show the following percentages: "incipient," 28 per cent., "moderately advanced," 66 per cent., and "far advanced," 6 per cent. (These figures omit from consideration patients in that sanatorium under three months). Of 1192 patients admitted to Loomis Sanatorium from 1916 to 1920 the percentages were as follows: "incipient," 13 per cent., "moderately advanced," 39 per cent., and "far advanced," 48 per cent. Of the 1707 patients admitted to the King Edward VII Sanatorium from 1907 to 1914 the cases were distributed as follows: "incipient," 27 per cent., "moderately advanced," 50 per cent., and "far advanced," 23 per cent.

The fairly high proportion of early cases at Mt. McGregor is the result of a systematic effort on the part of the Company to search out employees with tuberculosis. To this end an annual examination of the entire force was instituted eight years ago and has been persistently continued each year since to bring above the "clinical horizon" cases in the early stages of the disease. It may not be out of place to say that in the determination of whether or not tuberculosis in its early stages actually existed in these patients every diagnostic facility was brought to bear upon the case, and it was only after prolonged and thorough study that the final diagnosis was made. Furthermore, there has never been any incentive to make a diagnosis of tuberculosis in order that a patient might be permitted to remain in the Sanatorium, because from the very beginning non-tuberculosis patients have been treated, and the duty of the physicians was to make a diagnosis as accurately as possible whatever it might prove to be. Obviously at the beginning when the Sanatorium had just opened it was inevitable that a large proportion of the cases would be "moderately advanced" and "far advanced," but with the progress of time the proportion of "incipients" has rapidly increased, and in one year, namely 1920, the proportion of "incipients" was as high as 70 per cent. The following table shows year by year since 1914 the proportion of the three classes of cases.

This is a composite result, being the combined experience for the employees of the Home Office and of the Field. It is probably true that the examinations in the Home Office are more effective than in the Field, the former being concentrated in the hands of a few examiners under the direct supervision of those responsible for the health of the force. In the Field, the work is more loosely supervised, as it must be, involving a large number of physicians of very different training and ability to discover early tuberculosis. No group in the Field force is under the direct and constant supervision of medical officers, as is the entire group of employees in the Home Office. The results of this difference show up very interestingly. Thus in the Home Office 65 per

TABLE 1

Number and per cent of admissions, 1914–1921, according to condition on admission

	TOTAL		INCIPIENT		MODERATELY ADVANCED		FAR ADVANCED	
	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent
All years	1319	100.0	738	56.0	493	37.3	88	6.7
1914	127	100.0	36	28.3	73	57.5	18	14.2
1915	157	100.0	68	43.3	82	52.2	7	4.5
1916	223	100.0	120	53.8	94	42.2	9	4.0
1917	218	100.0	145	66.5	68	31.2	5	2.3
1918	145	100.0	76	52.4	62	42.8	7	4.8
1919	183	100.0	119	65.0	47	25.7	17	9.3
1920	150	100.0	105	70.0	38	25.3	7	4.7
1921	116	100.0	69	59.5	29	25.0	18	15.5

cent. of the admissions are "incipient" as against only 50 per cent. in the Field. Thirty-two per cent. of the Home Office are admitted "moderately advanced" as against 41 per cent. in the Field. Only 3 per cent. of the Home Office admissions are "far advanced" as compared with 9 per cent. from the Field. In more recent years the experience in the Field has been very much improved, due largely to the increased interest of the managers in the welfare of their own staffs. It is not an uncommon thing for a manager to become concerned about the health of some agent or clerk in his employ through the dropping off in his efficiency. Such an employee is then given a special physical examination. A number of cases of "incipient" disease have been discovered in this wise. The return to various districts of discharged tuberculous patients and the knowledge of the detection of tuberculosis which they impart to the other members of the staff have played not a small part in the bringing of early cases of tuberculosis to the Sanatorium in increasing numbers during recent years.

The purpose of the Sanatorium is definitely to rehabilitate the employees as completely as possible, and everything in the organization is directed toward that end. The patient is advised to remain under treatment until his condition warrants his return to work. The seriously advanced or progressive case is welcome to remain in the Sanatorium if he or she chooses. The result of this policy is a somewhat longer average period of stay than is usually found in sanatorium practice. During the entire history of the Sanatorium the average duration of stay for tuberculous patients has been for "incipients" 7 months, 1 day; for "moderately advanced" cases 12 months, 18 days, and for "far advanced" cases 14 months, 10 days. The group as a whole, irrespective of condition on admission, gives an average duration of 9 months, and 29 days care. These figures, of course, seriously affect the character of the results achieved, as pointed out later.

We should point out also what we consider a favorable feature of the Sanatorium service, namely the ability of the Company to place the discharged patient immediately at work. His position is in a sense prepared for him before he leaves the Sanatorium, and in nearly all instances the interval between discharge and resumption of work does not exceed one week. In a very real sense the work to which the patient is discharged is a part of the tuberculosis therapy which the Company provides. It must not be assumed, however, that patients are discharged to work in anything but a real sense of the word. While it is occasionally true that selected patients will be located in certain more favorable areas and work, the great majority go back to their usual home environment and the same type of work from which they came. In the Home Office, employees are returned usually to their original division, and the only change in the regimen is a more frequent examination and the receipt of intermediate diets where there is an indication of loss of weight or of underweight. The important thing apparently is not the necessity for finding special work for them but the fact that there is work for them to do which they are capable of doing. There is not that intermediate period which usually harrasses the tuberculous patient, of finding work for which he is fitted.

We shall now proceed to consider the results obtained from these patients. First we shall consider the condition of the patients at the time of discharge, later we shall see how well these patients stand up after discharge.

Taking the group as a whole irrespective of the condition on admission, we find that of the 1018 cases under review 632 or 62 per cent. were discharged apparently arrested or quiescent; 229 or 23 per cent. improved; 92 or 9 per cent. as unimproved or progressive, and 65 or 6 per cent. as dead. This compares with the Trudeau group which showed apparently arrested or quiescent 68 per cent.; improved 15 per cent.; unimproved or progressive 16 per cent., and 1 per cent. as dead; with the Loomis Sanatorium group which showed apparently arrested or quiescent 42 per cent.; improved 28 per cent.; unimproved or progressive 22 per cent., and 8 per cent. as dead; with the King Edward VII Sanatorium which showed 63 per cent. apparently arrested or quiescent; 19 per cent. improved; 17 per cent. unimproved or progressive and none dead.

Too much emphasis must not be placed upon these differences. It is possible that they reflect the different uses of the terms designating the condition on discharge as well as the different practices of the institutions in discharging patients prior to death. It is well known that certain institutions prefer to discharge patients that are getting worse or who become moribund. Others encourage such patients to remain in the Sanatorium. Such divergence of practice will, of course, affect the several proportions materially. Taking all the facts together the above figures can with fairness be interpreted to indicate that the immediate results of the several institutions named above were not very different.

TABLE 2

Number and per cent discharged in various conditions, 1914–1920, according to condition on admission

CONDITION ON ADMISSION	TOTAL CASES		APPARENTLY ARRESTED OR QUIESCENT		IMPROVED		UNIMPROVED OR PROGRESSIVE		DEAD	
	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent
Total	1018	100.0	632	62.1	229	22.5	92	9.0	65	6.4
Incipient	592	100.0	478	80.7	88	14.9	19	3.2	7	1.2
Moderately advanced	366	100.0	152	41.5	133	36.4	48	13.1	33	9.0
Far advanced	60	100.0	2	3.3	8	13.3	25	41.7	25	41.7

TABLE 3

Comparison of results achieved on discharge according to condition on admission at four sanatoria

CONDITION ON DISCHARGE	TRUDEAU		LOOMIS		KING EDWARD VII		MT. MCGREGOR	
	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent
Total								
Total number of cases	1892	100.0	1192	100.0	1707	100.0	1018	100.0
Quiescent	1285	67.9	496	41.6	1080	63.3	632	62.1
Improved	287	15.2	335	28.1	330	19.3	229	22.5
Unimproved	307	16.2	258	21.7	297	17.4	92	9.0
Dead	13	0.7	103	8.6	0	0	65	6.4
1. Incipient on admission								
Total number of cases	534	100.0	153	100.0	460	100.0	592	100.0
Quiescent	408	76.4	114	74.5	427	92.8	478	80.7
Improved	73	13.7	32	20.9	16	3.5	88	14.9
Unimproved	52	9.7	7	4.6	17	3.7	19	3.2
Dead	1	0.2	0	0	0	0	7	1.2
2. Moderately advanced on admission								
Total number of cases	1254	100.0	471	100 0	848	100.0	366	100.0
Quiescent	847	67.5	257	54.5	555	65.4	152	41.5
Improved	185	14.8	112	23.8	160	18.9	133	36.4
Unimproved	212	16.9	80	17.0	133	15.7	48	13.1
Dead	10	0.8	22	4.7	0	0	33	9.0
3. Far advanced on admission								
Total number of cases	104	100.0	568	100.0	399	100.0	60	100.0
Quiescent	30	28.8	125	22.0	98	24.6	2	3.3
Improved	29	27.9	191	33.6	154	38.6	8	13.3
Unimproved	43	41.3	171	30.1	147	36.8	25	41.7
Dead	2	2.0	81	14.3	0	0	25	41.7

Interest is increased when we relate the results achieved through Sanatorium care to the condition of the patients on admission. Thus if we consider the "incipient" cases alone we find that 81 per cent. were discharged as apparently arrested or quiescent as compared with only 42 per cent. of the "moderately advanced" cases and only about 3 per cent. of the "far advanced" cases. Of the "incipient" cases on admission close to 15 per cent. were discharged improved; over 36 per cent. of the "moderately advanced" cases were so discharged, and 13 per cent. of the "far advanced" cases were so discharged. Conversely the proportion of patients discharged by death from the Sanatorium varies directly with their condition on admission. Thus of the "incipients" 1 per cent. died within the Sanatorium, 9 per cent. among the "moderately advanced" cases and 42 per cent. among the "far advanced" cases. Such is the significance of the condition on admission in determining the results that are likely to be obtained.

Table 2 shows in detail the condition of the patients on discharge in relation to their condition on admission.

We may now compare some of these results with those attained in other sanatoria. To avoid repetition we have constructed the accompanying table which compares the results at Trudeau for a period from 1911 to 1920; at Loomis from 1916 to 1920, and at King Edward VII Sanatorium from 1907 to 1914 with those for Mt. McGregor from 1914 to 1920.

It will be a very interesting thing to see whether these proportions at Mt. McGregor have changed materially with the advancing years, whether for example, the degree of success as measured by condition on discharge is higher for later years than for earlier ones. Combining the experience

TABLE 4

Comparisons of results of treatment from 1914 to 1917 and from 1918 to 1920

CONDITION ON ADMISSION	TOTAL CASES		APPARENTLY ARRESTED OR QUIESCENT		IMPROVED		UNIMPROVED OR PROGRESSIVE		DEAD	
	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent
a. 1914–1917										
Total	513	100.0	310	60.4	118	23.0	58	11.3	27	5.3
Incipient	269	100.0	208	77.3	45	16.7	11	4.1	5	1.9
Moderately advanced	214	100.0	101	47.2	69	32.2	34	15.9	10	4.7
Far advanced	30	100.0	1	3.3	4	13.3	13	43.4	12	40.0
b. 1918–1920										
Total	505	100.0	322	63.8	111	22.0	34	6.7	38	7.5
Incipient	323	100.0	270	83.6	43	13.3	8	2.4	2	0.7
Moderately advanced	152	100.0	51	33.6	64	42.1	14	9.2	23	15.1
Far advanced	30	100.0	1	3.3	4	13.3	12	40.0	13	43.4

of the first four years, 1914, 1915, 1916 and 1917 and contrasting them with the three years, 1918, 1919 and 1920 we present the foregoing table showing how the two classes compare as to condition on discharge in the two periods.

The sizes of groups for comparison are about the same, 513 for the period 1914-1917 and 505 for 1918-1920. The percentage of "incipient" cases that became arrested or quiescent from 1914 to 1917 was 77, from 1918 to 1920 it was 83. The percentage of "moderately advanced" cases that became quiescent in the earlier period was 47, and in the later period 33, while the "far advanced" cases becoming quiescent were 3 per cent. in both periods. We see then that there is practically no difference in the immediate results of treatment in the two periods under observation. The differences we have noted may be as much due to the differences in the use of terms and to the chance differences due to small numbers as to the actual differences in results achieved. Indeed, there was no essential change in the method of treatment in the later period or other known condition which should cause any great difference in the result. The routine had already been well established from the very beginning; no specific treatment has come in to improve the results. It is, therefore, understandable why there has been virtually no improvement with advance of time.

The measure of success of an institution lies not only in its ability to effect the arrest or the quiescence of its cases. It lies also in its ability to keep those arrested well and at work. To determine this factor it has been necessary to follow up the graduates of the Sanatorium and keep in close touch with them. The procedure has been as follows: A follow-up card has been devised (see San Form 54). This card is sent annually directly to all patients out of the Company's service with a cordial note requesting that it be filled out in detail. The ex-patient is invited to give as full an account of himself as he will. All ex-patients who are still in the Company's service have the benefit of annual examinations or those made at more frequent periods, and for this examination a medical card has been devised, a specimen of which is shown (San Form 54-A). This card, together with the patient's card above mentioned, is sent from the Sanatorium through the Home Office at the time of the ex-patient's annual examination. The entire record is transcribed on San Form 54-B. All ex-patients still in the service of the Company thus receive the benefits of a detailed and annual physical examination from which we receive a comprehensive report. In these cases we also know fully about the ex-patient's working capacity. From the ex-patients still in the Company's service the replies received total 100 per cent. From those who have left the service the replies total 94 per cent., and we expect that some of the still missing cases will ultimately come to our hand. We desire to acknowledge our obligation to Dr. C. L. Christiernin for his active aid in tracing and securing valued information from our ex-patients.

At first glance one would say that our problem is simplified because all the patients are the employees of one company. Indeed this would be

true if all of the employees discharged from the Sanatorium continued in the service of the Company after discharge. It would be a relatively easy matter to keep track of them. But in spite of the favorable character of the occupation and its conduciveness to the maintenance of health many, for various reasons, see fit to leave the Company and in that way may fall out of touch with it. Especially during the war period there was a very heavy turn-over of employees, attracted most likely by the abnormally high wages which were paid in some industries. The results of the follow-up are encouraging in the possibility which they show for keeping patients under observation after discharge, even over a certain number of years. It is pertinent at this point to say that it has never been the desire of the Company to rid itself of employees because of physical unfitness. Where this incapacity continues it has been the common experience that the employees have remained attached to the Company in some way, usually as beneficiaries of disability insurance or retired on an allowance. Of the 152 deaths from among those treated at the Sanatorium 119 have died in the Company's service and 33 out of the Company's service.

With such limitations as are inherent in any follow-up system we are able at this time to make the following tentative report of the status of the patients on December 31, 1921:

TABLE 5

Status of ex-patients on December 31, 1921, according to condition on admission

STATUS ON DECEMBER 31, 1921	TOTAL		INCIPIENT		MODERATELY ADVANCED		FAR ADVANCED	
	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent
Total	953	100.0	585	100.0	333	100.0	35	100.0
At work	719	75.4	491	83.9	221	66.4	7	20.0
Unable to work:								
Readmitted and still at sanatorium	23	2.4	11	1.9	12	3.6	0	0
Not at sanatorium	67	7.0	25	4.3	35	10.5	7	20.0
Dead	87	9.2	18	3.1	49	14.7	20	57.1
Unable to trace	57	6.0	40	6.8	16	4.8	1	2.9

Significant as the above table is and encouraging in its showing, it is marred by the existence of 57 cases of ex-patients who have left the service of the Company and who were not traceable after every effort. Of this number, 14 were in touch with the Sanatorium as late as 1920. That they are not, to any appreciable extent, patients who have died and are untraceable on that account is indicated by the fact that out of a previous lot who were not traced at an earlier date only one death was discovered in a total of 100 cases of this character. As a matter of fact 40 of the 57 were "incipients" on admission; 16 were "moderately advanced" cases, and one was a "far advanced" case. It would, therefore,

RESULTS OF FOLLOW-UP OF SANATORIUM TUBERCULOUS DISCHARGES ACCORDING TO CONDITION ON ADMISSION AND ON DISCHARGE, 1914-1920

STATUS ON December 31, 1921	1914–1920 Discharged As:				1920 Discharged As:				1919 Discharged As:				1918 Discharged As:				1917 Discharged As:				1916 Discharged As:				1915 Discharged As:				1914 Discharged As:			
	TOTAL CASES	Apparently Arrested Quiescent	IMPROVED	Unimproved Progressive	TOTAL CASES	Apparently Arrested Quiescent	IMPROVED	Unimproved Progressive	TOTAL CASES	Apparently Arrested Quiescent	IMPROVED	Unimproved Progressive	TOTAL CASES	Apparently Arrested Quiescent	IMPROVED	Unimproved Progressive	TOTAL CASES	Apparently Arrested Quiescent	IMPROVED	Unimproved Progressive	TOTAL CASES	Apparently Arrested Quiescent	IMPROVED	Unimproved Progressive	TOTAL CASES	Apparently Arrested Quiescent	IMPROVED	Unimproved Progressive	TOTAL CASES	Apparently Arrested Quiescent	IMPROVED	Unimproved Progressive
TOTAL																																
TOTAL	953	632	229	92	159	103	40	16	138	96	31	11	170	123	40	7	239	169	55	15	126	71	31	24	102	62	30	10	19	8	2	9
In Service of Company	519	352	120	47	99	64	25	10	81	60	15	6	104	74	28	2	114	86	20	8	57	34	13	10	55	30	18	7	9	4	1	4
Discontinued	434	280	109	45	60	39	15	6	57	36	16	5	66	49	12	5	125	83	35	7	69	37	18	14	47	32	12	3	10	4	1	5
At Work	719	541	151	27	129	94	30	5	107	83	22	2	130	104	26	0	179	142	34	3	93	61	20	12	71	51	17	3	10	6	2	2
Unable to work Readmitted and still at Sanatorium	23	10	11	2	5	3	2	0	8	4	2	2	6	2	4	0	2	0	2	0	1	1	0	0	1	0	1	0	0	0	0	0
Not at Sanatorium	67	36	18	13	13	5	4	4	10	3	2	5	12	8	2	2	14	11	3	0	12	6	4	2	5	2	3	0	1	1	0	0
Dead	87	12	29	46	9		2	7	4	0	2	2	14	3	6	5	20	4	6	10	16	1	6	9	16	3	7	6	8	1	0	7
Unable to Trace	57	33	20	4	3	1	2	0	9	6	3	0	8	6	2	0	24	12	10	2	4	2	1	1	9	6	2	1	0	0	0	0
(A) INCIPIENT TUBERCULOSIS ON ADMISSION																																
TOTAL	585	478	88	19	117	95	18	4	93	79	11	3	111	96	14	1	143	118	21	4	72	52	15	5	43	33	9	1	6	5	0	1
In Service of Company	302	256	41	5	74	58	13	3	52	48	3	1	63	54	9	0	65	59	5	1	31	25	6	0	15	10	5	0	2	2	0	0
Discontinued	283	222	47	14	43	37	5	1	41	31	8	2	48	42	5	1	78	59	16	3	41	27	9	5	28	23	4	1	4	3	0	1
At Work	491	414	64	13	105	88	14	3	74	67	6	1	94	83	11	0	115	99	13	3	65	48	13	4	33	25	7	1	5	4	0	1
Unable to work Readmitted and still at Sanatorium	11	8	3	0	5	3	2	0	4	4	0	0	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Not at Sanatorium	25	18	3	4	4	3	0	1	6	2	2	2	5	4	0	1	8	7	1	0	1	1	0	0	1	1	0	0	0	0	0	0
Dead	18	10	8	0	1	0	1	0	0	0	0	0	5	3	2	0	5	4	1	0	3	1	2	0	3	1	2	0	1	1	0	0
Unable to Trace	40	28	10	2	2	1	1	0	9	6	3	0	5	5	0	0	15	8	6	1	3	2	0	1	6	6	0	0	0	0	0	0

(B) MODERATELY ADVANCED TUBERCULOSIS ON ADMISSION

TOTAL	333	152	133	48	31	7	19	5	43	17	20	6	55	27	25	3	92	51	33	8	46	19	15	12	55	29	19	7	11	2	2	7
In Service of Company	194	94	74	26	18	5	10	3	28	12	12	4	40	20	18	2	46	27	15	4	20	9	6	5	37	20	12	5	5	1	1	3
Discontinued	139	58	59	22	13	2	9	2	15	5	8	2	15	7	7	1	46	24	18	4	26	10	9	7	18	9	7	2	6	1	1	4
At Work	221	126	83	12	20	5	13	2	33	16	16	1	35	21	14	0	64	43	21	0	26	13	7	6	38	26	10	2	5	2	2	1
Unable to work Readmitted and still at Sanatorium	12	2	8	2	0	0	0	0	4	0	2	2	4	1	3	0	2	0	2	0	1	1	0	0	1	0	1	0	0	0	0	0
Not at Sanatorium	35	17	14	4	6	2	4	0	3	1	0	2	6	4	2	0	6	4	2	0	11	5	4	2	3	1	2	0	0	0	0	0
Dead	49	2	19	28	4	0	1	3	3	0	2	1	7	0	4	3	12	0	5	7	7	0	3	4	10	2	4	4	6	0	0	6
Unable to Trace	16	5	9	2	1	0	1	0	0	0	0	0	3	1	2	0	8	4	3	1	1	0	1	0	3	0	2	1	0	0	0	0

(C) FAR ADVANCED TUBERCULOSIS ON ADMISSION

TOTAL	35	2	8	25	11	1	3	7	2	0	0	2	4	0	1	3	4	0	1	3	8	0	1	7	4	0	2	2	2	1	0	1
In Service of Company	23	2	5	16	7	1	2	4	1	0	0	1	1	0	1	0	3	0	0	3	6	0	1	5	3	0	1	2	2	1	0	1
Discontinued	12	0	3	9	4	0	1	3	1	0	0	1	3	0	0	3	1	0	1	0	2	0	0	2	1	0	1	0	0	0	0	0
At Work	7	1	4	2	4	1	3	0	0	0	0	0	1	0	1	0	0	0	0	0	2	0	0	2	0	0	0	0	0	0	0	0
Unable to work Readmitted and still at Sanatorium	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Not at Sanatorium	7	1	1	5	3	0	0	3	1	0	0	1	1	0	0	1	0	0	0	0	0	0	0	0	1	0	1	0	1	1	0	0
Dead	20	0	2	18	4	0	0	4	1	0	0	1	2	0	0	2	3	0	0	3	6	0	1	5	3	0	1	2	1	0	0	1
Unable to Trace	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0

seem very reasonable to suppose that the follow-up history of these people was better, if anything, than that of the group as a whole. These people belong to the group of dissatisfied persons, who, for some reason known only to themselves, do not wish to keep in close touch with the Company.

The main results may, therefore, be summarized as follows: Out of the 896 patients who were discharged from the beginning up to December 31, 1920, and on whom a report was available as of December 31, 1921, 719 or 80 per cent. were known to be at work; 90 or 10 per cent. were unable to work, and 87 or 10 per cent. were dead.

As might be expected, these figures will vary directly with the condition of the patients on admission. Of the 585 "incipients," of whom 545 were traced, 491 or 90 per cent. were at work on December 31, 1921, only 18 or 3 per cent. were dead and 36 or 7 per cent. were unable to work. Of the 333 "moderately advanced" cases on admission, of whom 317 were traceable, 221 or 70 per cent. were still at work and 49 or 15 per cent. were dead. Finally of the 35 "far advanced" cases 34 were traceable, and of this number only 7 or 20 per cent. were at work, and a total of 20 or 60 per cent. were dead. The ability to keep at work after discharge varies directly with the condition of the patients on admission.

It is at this time impossible, in view of the limited duration of this experience, to compare the results of ability to stay alive and at work of these patients with those of other sanatoria. It will be our purpose in the future to make such comparisons, but even at the present time it would appear from the figures that the results achieved are entirely consistent with the expectation that our patients will maintain as high a rate of capacity to stay at work as that achieved by the best sanatoria.

At this time it is also possible to make a rather rough comparison of the actual mortality which has occurred among these ex-patients with that expected from them with due regard to their age. Among the 585 "incipient" cases, for example, there were 18 deaths. In the aggregate they lived a total of 1868 years during this period of observation. At the rate of 5 per 1000 deaths, which prevails among the staff of the employees of the Metropolitan, there would have been about 9 expected deaths. In other words, even this very best group shows a mortality twice as high as the expected. This is in entire agreement with the work of King.

We intend at a subsequent time to supplement these studies with comparisons not only between the actual and expected mortality of our patients but also on the effects on the prognosis of certain other interesting factors, such as the presence of tubercle bacilli in the sputum, the age of the patients on admission, the stock from which they descend and the character of occupations pursued by those who leave the Company's service.

Metropolitan Life Insurance Company Sanatorium—Patient's Post-Sanatorium History Form San. 54

Name of patient | Present address

Present occupation | Change of occupation or of residence contemplated. Please specify

Present weight	Hours of work per day	Earnings Weekly Before coming to Sanatorium	Present	Time Absent from Work During Past Year: Vacation	Illness	Other cause

Specify illnesses you have had during past year. Give dates and specify whether medical attendance was required

Have You Had Any of the Following Symptoms During Past Year? Write "Yes" or "No" Under Each Item

Cough How long	Expectoration	Pain in chest	Night sweats	Hemorrhage	Shortness of breath	Elevation of temperature

What was highest temperature?	How long did it last?	Cause	Have you had your sputum examined?	Result

Has any case of tuberculosis arisen in your immediate family?	Please specify	Do you sleep out of doors?	Please specify sleeping arrangements	Are you as well as when you left the Sanatorium?

Have you taken part in educational work for the prevention of tuberculosis? Give details of service rendered on reverse side of card

Has your Sanatorium experience helped you in your work? | How?

Have you improved your own living conditions as a result of your experience at Mount McGregor? How? (Over)

Name of your physician | His address:

Comment on present state of health or on results of Sanatorium treatment.

Date.....19..... Signed.....

FIG. 1. FOLLOW-UP CARD
Front and back views

Metropolitan Life Insurance Company Sanatorium—Physician's Statement of Post-Sanatorium History Form San. 54A

Name of patient | Address

Present occupation | Date discharged From San. | Classification on Discharge: Turban stage | Condition | Complications

Please give history of non-tuberculous disease during past year.

Please give history of pulmonary signs and symptoms during past year. (On reverse side, give your findings upon examination of patient)

During Past Year, Has Patient's Condition: Improved? | Remained stationary? | Become progressive?

Sputum Examination: Date | Findings

Do you recommend change in patient's occupation or residence?

In Case of Death of Patient, Please Give:

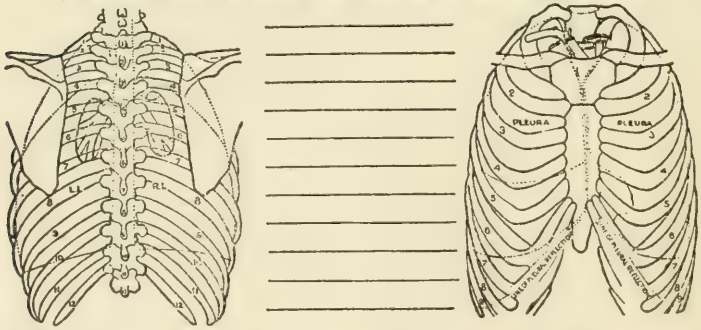
Determining cause of death:..... Duration:.....years.....months.....days

Secondary cause of death:..... Duration:.....years.....months.....days

Date of patient's death | Signed:.....M. D. | Residence..... | Date of this report .....19..

(Over)

Upon examination of patient, what were your findings. Please enter below the findings from your diagram:



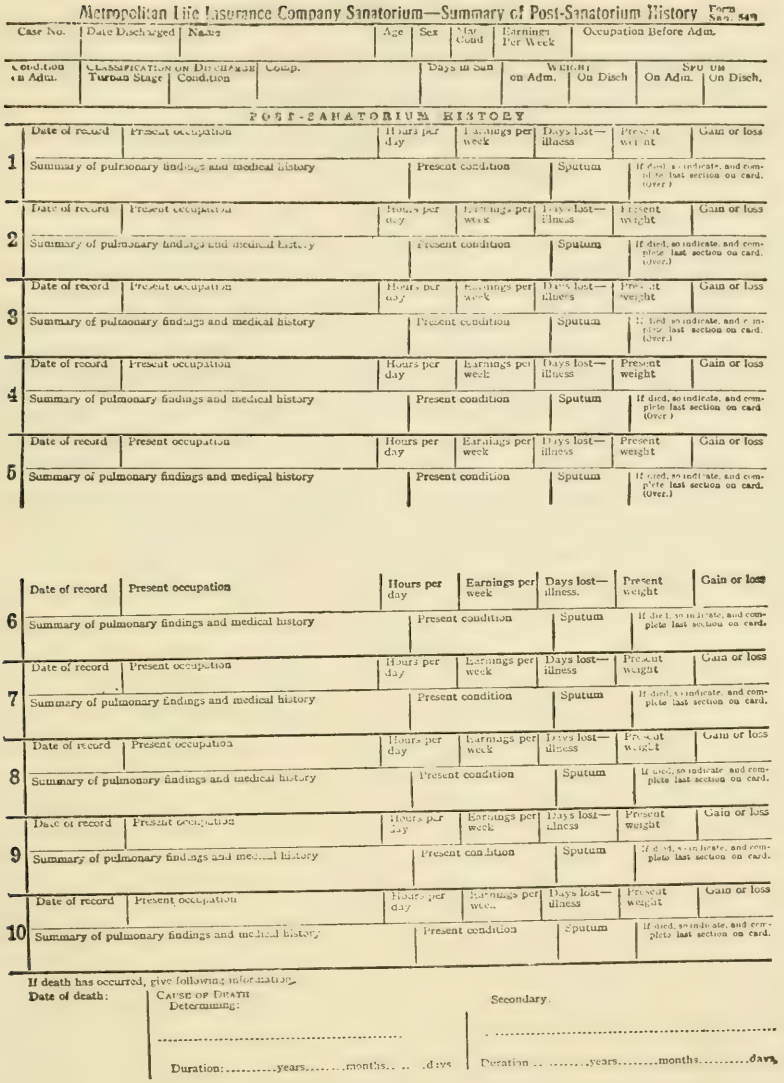
/// Slight dullness
XX Moderate dullness
Flatness
VR+ Voc. Res. Increased
VR− Voc. Res. Diminished

P Prolonged expiration
BV Broncho-vesicular breathing
BB Bronchial breathing
AB Absent breathing

Crepitant rales
Large moist rales
Gurgles
Sonorous rales
Clicks

Friction
d Rales on deep breathing only
C Rales after coughing only
Cavity signs

FIG. 2. MEDICAL CARD
Front and back views



Metropolitan Life Insurance Company Sanatorium—Summary of Post-Sanatorium History Form San. 549

Case No. | Date Discharged | Name | Age | Sex | Mar. Cond | Earnings Per Week | Occupation Before Adm.

Condition on Adm. | Classification on Discharge: Turban Stage | Condition | Comp. | Days in San | Weight: on Adm. | On Disch | Sputum: On Adm. | On Disch.

POST-SANATORIUM HISTORY

	Date of record	Present occupation	Hours per day	Earnings per week	Days lost—illness	Present weight	Gain or loss
1	Summary of pulmonary findings and medical history		Present condition		Sputum	If died, so indicate, and complete last section on card. (Over.)	
2	Date of record / Summary of pulmonary findings and medical history	Present occupation	Hours per day	Earnings per week	Days lost—illness	Present weight	Gain or loss
			Present condition		Sputum	If died, so indicate, and complete last section on card. (Over.)	
3	Date of record / Summary of pulmonary findings and medical history	Present occupation	Hours per day	Earnings per week	Days lost—illness	Present weight	Gain or loss
			Present condition		Sputum	If died, so indicate, and complete last section on card. (Over.)	
4	Date of record / Summary of pulmonary findings and medical history	Present occupation	Hours per day	Earnings per week	Days lost—illness	Present weight	Gain or loss
			Present condition		Sputum	If died, so indicate, and complete last section on card. (Over.)	
5	Date of record / Summary of pulmonary findings and medical history	Present occupation	Hours per day	Earnings per week	Days lost—illness	Present weight	Gain or loss
			Present condition		Sputum	If died, so indicate, and complete last section on card. (Over.)	
6	Date of record / Summary of pulmonary findings and medical history	Present occupation	Hours per day	Earnings per week	Days lost—illness.	Present weight	Gain or loss
			Present condition		Sputum	If died, so indicate, and complete last section on card.	
7	Date of record / Summary of pulmonary findings and medical history	Present occupation	Hours per day	Earnings per week	Days lost—illness	Present weight	Gain or loss
			Present condition		Sputum	If died, so indicate, and complete last section on card.	
8	Date of record / Summary of pulmonary findings and medical history	Present occupation	Hours per day	Earnings per week	Days lost—illness	Present weight	Gain or loss
			Present condition		Sputum	If died, so indicate, and complete last section on card.	
9	Date of record / Summary of pulmonary findings and medical history	Present occupation	Hours per day	Earnings per week	Days lost—illness	Present weight	Gain or loss
			Present condition		Sputum	If died, so indicate, and complete last section on card.	
10	Date of record / Summary of pulmonary findings and medical history	Present occupation	Hours per day	Earnings per week	Days lost—illness	Present weight	Gain or loss
			Present condition		Sputum	If died, so indicate, and complete last section on card.	

If death has occurred, give following information.

Date of death: | Cause of Death Determining: ..... Duration: .....years.....months.....days | Secondary. ..... Duration .....years.....months.....days.

FIG. 3. POST-SANATORIUM RECORD CARD
Front and back views

DISCUSSION ON PAPER BY DR. HOWK, DR. DUBLIN AND MISS KNUDSEN

Dr. B. S. Antonowsky, Liberty, N. Y.: I just want to ask how long after discharge, do these tables appertain to these cases?

Dr. Dublin: These tables were made a month ago; they were all based upon replies received subsequent to December 31, 1921.

Dr. Antonowsky: How many of these cases were out of the sanatorium one year or half a year, and how many were out of the sanatorium ten years?

Dr. Dublin: That was explained. These cases have been discharged from 1913 on, a variable number each year. Some of these cases have been out of the sanatorium one year, some have been out as many as seven full years. The average period is about five years, because of the heavier influx of cases at the beginning than more recently. There are some recently discharged cases, none less than one year; a goodly number discharged seven years ago, but they were all heard from subsequent to December 31, 1921, with the exception of 57 cases that could not be traced, but even these 57 were traced partially; the largest number of them were traced up to December 31, 1920.

A PHYSIOLOGICAL ADJUVANT IN THE REST CURE OF PULMONARY TUBERCULOSIS*

By S. Adolphus Knopf, M.D.

New York

Ever since Dettweiler[1] devised the rest cure on a reclining chair in the open air, as a means of accomplishing a cure in pulmonary tuberculosis, the idea of exercise in the open air as a therapeutic measure has been abandoned by the majority of physicians. In later years various clinicians, and in this country especially the late Charles Denison,[2] Norman Bridge,[3] and Henry Sewall[4] have endeavored to add to the general rest the local restriction of the respiratory movements. This method was tried first with simple adhesive strips encircling the chest. In a very interesting recent contribution on this subject by Sewall and Swezey,[4] an ingenious belt is described whereby the respiratory excursions are limited. According to these authors the results were surprisingly satisfactory in view of the fact that the patients who underwent the treatment were in the advanced stages of the disease and had been refractory to the usual modes of treatment.

Of course, this attempt to restrict the respiratory movements in order to give local rest to the lung cannot be compared with the results obtained by successful artificial pneumothorax where the involved lung is completely collapsed and, so to speak, put out of commission. Of the results of artificial pneumothorax in the early, moderately advanced, and far advanced stages of the disease so much has been written that it would encroach too much upon the time of the reader to try to give any statistics. We all know that there is a vast difference of opinion concerning the utility of artificial pneumothorax, particularly in the early cases, and we know also that, owing to pleuritic adhesions, the number of advanced cases of pulmonary tuberculosis suitable for this operation has thus far been limited.

The latest achievements of Prof. H. C. Jacobaeus of Stockholm[5] who, with the aid of the thoracoscope and a long cautery protected by a cannula, divides the pleuritic adhesions, may help to diminish the number of cases which have heretofore been considered as unsuited for artificial pneumothorax. Some French experimenters even resorted to the bistoury, properly protected, to sever the adhesions. Thoracoplastic opera-

*Read before the tuberculosis staff of the U. S. Veterans' Hospital No. 61, Fox Hills, New York, March 16, 1922. Approved for publication by the Surgeon-General of the U. S. Public Health Service.

tions may also, perhaps, be more frequently resorted to hereafter for the same purpose, as the operation becomes better perfected. Of course, the two latter procedures must always be considered more or less dangerous. In dividing the pleuritic bands with the bistoury, or even with the electric cautery, there will always be some danger of coming across very vascular adhesions, or such extensive ones that there may be danger of hemorrhage and rupturing the lung. The thoracopneumoplastic operation so far has yielded a rather high mortality, even at the hands of so skillful a surgeon as Archibald,[6] so that it must be restricted to very few cases.

All the procedures just described, however, have one sole object in view, namely, to limit or to restrict entirely the respiratory movements of the diseased lung. From observing animal life and from the study of comparative physiology[7] the thought has come to me that the slow breathing animal seems to be the longest lived. The rabbit which is the most susceptible to tuberculosis, particularly the bovine type, breathes 55 times a minute; the adult guinea pig 80 times; the young guinea pig 140 times a minute. It is well known that the guinea pig is very susceptible to both types of tuberculosis. The horse which, of all the domesticated animals, is the least susceptible to tuberculosis, breathes only ten times a minute when at rest. The cow, on the other hand, contracting tuberculosis most easily, breathes fifteen to thirty times per minute. The animal which perhaps lives longest is the turtle whose respirations are so few per minute that they are hardly perceptible.

Now, if according to the foregoing, the slowly breathing animal is least susceptible to the invasion of tuberculosis, and a lung infected by tuberculosis is benefited by restriction of its respiratory movements through outside pressure or by the complete arrest of function by means of an air splint (artificial pneumothorax) or bone compression, why should not restricted respiratory movements and reduction in their number by voluntary effort be equally valuable as an adjuvant in the cure of pulmonary tuberculosis?

I first experimented on myself and by resorting to diaphragmatic breathing have been able to reduce my respirations, without discomfort, to 8, 6, and sometimes 5 per minute. I recommended this to a few of my patients in various stages of the disease and I was surprised to find how well they could train themselves to reduce their respiratory movements from 24 and 30 per minute to 10, 8, and 6, and do this gradually for half an hour to one hour at a time and do it several times a day.

As far as I had gone, the patients did not experience any discomfort from these exercises, but felt better, and their general condition as well as their local lesions improved markedly. One patient confessed to me that after restricting the number of his respiratory movements, he experienced an intense desire to take a deep breath. Having been instructed not to do so, he imagined himself to feel very uncomfortable. I told him that the next time he felt like taking a deep inspiration, he should not hesitate to follow his inclination. A few days later he assured me that the

thought that he could take a deep breath when he wanted to made him feel much more comfortable and that he could keep up his restricted breathing for a longer time. Although I knew from my clinical experience that patients can live and breathe when there is virtually only one-fourth or even less of lung area in condition to attend to the oxygenation necessary for life, I did not feel certain about the wisdom of my procedure as a therapeutic means. I feared that perhaps through this method of producing physiological rest, I might in the long run do harm to my patients by allowing an accumulation of carbon dioxide and a privation of oxygen. According to Weber[8] and his followers, it would seem that a moderate accumulation of carbon dioxide is not by any means to be feared but rather to be favored in pulmonary tuberculosis. Nevertheless, to be on the safe side, I consulted Dr. Graham Lusk, Professor of Physiology of Cornell University Medical College, and demonstrated for him this method of breathing, and to his surprise I was able to reduce my respirations to 4 per minute. He told me that in his opinion no possible harm could be done to any one by using superficial respiration, restricting the number of respirations per minute or diaphragmatic breathing. Wishing to have something authentic on the subject, I asked him to be good enough to write me his opinion, with permission to use it in this article, and he most kindly wrote me as follows:

> Under ordinary conditions the production of carbon dioxide in the tissues controls the volume of the respiration. If the number of respirations per minute be decreased, the volume of air expired and inspired per breath is automatically increased. The total gaseous exchange, however, remains approximately the same. Under ordinary conditions of rest the quantity of oxygen absorbed is almost the same whether there be seven or fifteen respirations per minute.

The statement by Professor Lusk concerning the automatic increase of the volume of air expired and inspired per breath, I have not only been able to verify by interesting experiments, but to my surprise I found that the volume of air inspired and expired when the respiration is limited to the basal portions of the lungs, that is to say, the volume of tidal air, is even materially increased above the normal. Through the courtesy of Professor Lusk and with the valuable coöperation of Dr. D. P. Barr of the Russell Sage Institute of Pathology, I was permitted to make some spirometric tests during the respirations limited in number and restricted to the diaphragmatic mode of breathing. Dr. Barr kindly lent himself to the experiment. After I had demonstrated to him how he could diminish the number of respirations to 5 per minute and limit them to the basal portion of the lungs, he was surprised to find with what comfort he could do it, and thought he could do it indefinitely. Dr. Barr has an unusally well developed chest and in ordinary respiration his tidal volume is 600 cc. per respiration. We both observed with interest that the volume of tidal air approximately doubled while he was lying in a recumbent position, breathing through the tube of the spirometer. We repeated the experiment twice, each time lasting for three

minutes, and the average number of inspirations and expirations did not exceed 5 per minute. Dr. Barr assured me that throughout the three periods of experimentation his respiration was comfortable and adequate, yet the upper portion of his lungs was virtually at rest.

It is of course possible, when one limits his respiratory function voluntarily, that there is an unconscious effort to take in more air than is actually needed. But this experiment proves that no harm can possibly be done by restricted respiration, and that a more thorough ventilation of the usually unaffected basal parts of the lungs in tuberculous patients can only be beneficial.

Besides the chemical stimulus to the continuance of respiration, there exists also a nervous stimulus, to which McCleod[9] refers in his article on *Some Recent Work on the Control of the Respiratory Centers.* He says: "There are in general two ways in which the activities of a center might be caused to alter. These are by changes in the chemical composition of the blood supplying it and by nerve impulses derived from other parts of the nervous system." In other words, the respiratory movements can, in no small degree, be controlled by the will. Norman Bridge, as far back as 1908, wrote concerning this as follows:

> Patients with active tuberculosis, who have been coughing much and been taking exercises of deep breathing, usually rather promptly discover an improvement in their sense of comfort and strength, as well as a perceptible decrease in fever, after they have adopted the plan of lessening the cough and keeping the lung as still as possible by will power measures.

Maurice Bourgois,[10] in his thesis on *Maximum d'apnée voluntaire* describes the method of choosing the type of men for aviators, which revealed the astounding fact that some men could remain as long as 65 seconds without breathing, merely by will power. While not exactly germane to the subject, it is interesting to note that those who could suspend their respiration from 50 to 65 seconds, were considered especially fitted. Those who could hold their breath for 40 or 45 seconds were admitted, while those who could suspend their respirations for only 15 or 20 seconds were rejected. These examinations certainly show the great power which the mind can exert over the respiratory function.

The reason for the improvement in my patients, and particularly in those who faithfully carried out my instructions concerning diminution of respiratory movements, I believe to be the relative rest which had been given to the lung by this process.

There is also a possibility, if this restricted breathing should really allow a little more of the carbon dioxide, but not enough in quantity to be harmful, to remain in the system in the nonventilated portion of the lungs, that this too may have had a beneficial effect. Corper, Gauss, and Rensch, in their admirable experimental work,[11] have substantiated Weber's belief that a deficiency of carbon dioxide in the body favors tuberculosis, while an accumulation retards its progress. They, however,

thoroughly disagree with Weber's treatment of advanced cases of tuberculosis, which consists in giving sodium bicarbonate and hydrochloric acid by mouth, with feedings of levulose combined in severe cases with subcutaneous injections of liquid paraffine (10 grams twice daily). Corper and his colleagues very justly say that paraffine oil cannot produce carbon dioxide in the metabolism of the body. Personally, I believe that even if we should ever succeed in introducing carbon dioxide into the system by medication or nutrition, its dosage would prove as difficult as it would be dangerous.

I am not going to burden this paper with calculations concerning how many hours during the day some of my patients succeeded in doing diaphragmatic breathing and in reducing their respirations. Suffice it to say, that if one succeeded in reducing his respiration from 20 per minute to 10, he has spared his lung 3000 movements in five hours. Even if it seems difficult for the patient to reduce the number of respiratory movements for any appreciable time, he will derive considerable benefit from shallow respiration or limiting his respiration to the basal portion of the lung. This part of the procedure, intended to obtain local rest for the invaded upper portion of the pulmonary area, is with some patients relatively easier to carry out than the voluntary reduction of the number of respirations per minute.

Of course, when one palpates the anterior portion of the chest carefully over the upper lobes, one may perceive a slight movement, particularly in beginners, but this diminishes as the patient becomes more habituated to diaphragmatic breathing. I question whether there exists any method of obtaining absolute rest for any part of the lung except by a successful artificial pneumothorax operation. No matter how perfect the methods of external application of compressing the lung by adhesive plaster or belt may seem, it is anatomically and physiologically impossible to compress the bony frame of the thorax to the extent of procuring absolute immobility of the underlying organs.

This fact no doubt inspired Webb and his co-workers, Forster and Houck[12] to investigate the value of simple posture in the treatment of pulmonary tuberculosis. These observers found that patients who slept or rested during the day on the side of their diseased lung did a great deal better than those who slept on the opposite or well side. To add this treatment by posture, particularly during sleep, to the respiratory method described in this paper, can of course only be of additional advantage.

In this communication I shall not only refrain from entering into the details of my cases, but will also avoid all statistics of cure, half-cure, arrest, improvement, or failure. I shall, however, refer to the results obtained in a few cases in the advanced stages with cavitation in my service at Fox Hills and in private practice. The patients had the usual symptoms of toxin absorption. After practising this method of breathing for a couple of weeks, cough, expectoration, and temperature gradually but perceptibly diminished, and auscultation revealed a decided tendency

to fibrous repair. But a few cases and the observations of one man alone in the treatment of tuberculosis cannot and should never be considered conclusive. All I will venture to do, therefore, is to give my ideas on the subject, describe the *modus operandi* and ask my fellow practitioners to try it on as large a scale as possible in early, moderately advanced, and even far advanced cases, and after a thorough trial send me their reports. That the results will be best in the early cases must be evident. That the results must be better when the general rest treatment in the open air and the proper hygienic, dietetic, and symptomatic treatment are carried out at the same time, than if the diminution of the respiratory movement is the sole remedy resorted to, is also obvious.

At the beginning of the treatment the patient lies on his reclining chair or preferably in bed with his head low. Later on, he may be able to resort to this method of breathing in the proper sitting or even standing position. The intelligent coöperation of the patient can only be obtained by explaining to him at length the object and aim of the procedure. He may be told that it may take some time before he can perceive any improvement, but that it can in no wise be injurious to him, and that should he have the slightest discomfort he should merely stop it. He must be furthermore assured that it cannot bring on a hemorrhage although a hemoptysis may occur, as it does in all sorts of treatment, but that it is more likely to prevent one. When one occurs, the quiet and diminished respiratory movements will rather help in the coagulation of the blood and in the arrest of hemorrhage because of the effect of diminishing the movements of the bleeding lung.

Two patients of mine who had had bloody expectoration and who stated that it always lasted many days, assured me that this quiet and diminished breathing shortened the usual duration of their blood spitting quite considerably. Of course, we all know that a hemorrhage or bloody expectoration may stop without any medication or other therapeutic means: general rest alone often suffices. Nevertheless, it is quite logical to assume that the respiratory movements being diminished in number and the respiration restricted to the lower portion of the lungs, rarely invaded by tuberculosis, may have an additional beneficial influence on the arrest of hemoptysis. Except shortly after hemorrhage, but as long as the patient still has sanguineous expectoration, he should be encouraged to drink plenty of pure water, preferably slightly alkaline, at least eight tumblerfuls per day between mealtimes. I noticed that those of my patients who obeyed this order were better able to reduce their respirations, and do it for a longer time, than those who were neglectful in carrying out instructions to drink water.

Modus operandi: The patient should be told to imagine that the respiratory movement begins in the toes of his right foot, the inhalation gradually travelling upward as far as the diaphragm on the right side and then over to the left side, and then gradually descends during expiration downward to the left. While, of course, this breathing from the toes upward and

as far as the abdomen is merely imaginary, it results in a diaphragmatic breathing and whatever quantity of air is inhaled passes mainly through the lower portions of the lungs, while the upper portion of the lungs, where tuberculous lesions are usually located, are put at comparative rest.

To be sure that the patient understands exactly what is meant by diaphragmatic breathing, it is well to teach it in the following manner: Place the patient in a sitting or half-reclining position, with his feet extended and slightly separated. Then tell him to inhale as slowly as the physician's hand with index finger pointing moves in the upward direction, beginning at the toes on the right foot, crossing the abdomen to the left, stopping 2, 3, 4 or 5 seconds and then exhaling while the hand moves in the downward direction to the left foot. This pause to retain the air can be gradually increased as the patient gains strength and control over his respiration. At the beginning he may only be able to hold his respiration one or two seconds while later he may be able gradually to increase the duration. A pause may also be made before the next inhalation is started. The physician or nurse teaching this breathing should repeat this procedure a few times until the patient fully grasps what he is asked to do and does it correctly. To this end it is well for the physician, while indicating the direction and duration of the inhalation with one hand, to place the other over the upper portions of the lung and thus observe whether they are at complete or at least at relative rest. When the patient is lying in the complete recumbent position, with head slightly elevated, the diaphragmatic breathing will be materially aided by placing a very small pillow or a folded bath towel under the small of the back.

Sometimes a belt or bandage, pinned or buckled so that it can be easily removed if the patient experiences a feeling of suffocation, may be put around the upper portion of the thorax to help in teaching how to limit breathing to the lower lobes.

In support of the statement that the breathing can thus be virtually limited to the basal portion of the lungs, I will quote from the above mentioned article by Sewall and Swezey as follows:

> When respiratory movement is limited to the diaphragm it is the very bases of the lungs that move most widely, the extent of motion rapidly diminishing upwards When the upper chest expands, respiratory motion involves the upper lobes in proportion to the excursion of the overlying ribs. Now, it is familiar enough that, broadly speaking, pulmonary tuberculosis is a disease of the upper part of the lungs, its intensity being concentrated between the hilum and the extreme apex.
>
> Remembering the data of our argument, the deduction is obvious that were we able to inhibit respiratory motion in, say, the first four ribs, we could, without seriously impairing the vital capacity of the chest, so restrict the motion of the principal areas of pulmonary disease that distribution of the toxins therefrom would be greatly reduced.

Retaining the freshly inhaled air for a few seconds, which is by no means harmful and can easily be done by most patients, will further

decrease the number of respirations per minute. When one considers that by this method of breathing not only the lungs but the heart also is spared many a movement and energy thus preserved to a considerable extent, its value must be obvious. Lawrason Brown[13] in his admirable "Rules for Recovery in Pulmonary Tuberculosis," has laid very great emphasis on cardiac rest. If, as he says, with each normal heart beat an energy equal to 4 foot-pounds is exerted, and by reduced and restricted breathing we save the heart only 2 or 3 contractions per minute by this method of respiration, we spare the heart from 2,400 to 3,600 foot-pounds of energy in 5 hours.

Lastly, diaphragmatic breathing will also cause a better circulation in the lower extremities and abdominal viscera, especially aiding the hepatic function, all of which is so essential for patients who are ordered complete physical rest on a reclining chair or bed.

I have been asked whether women who, for biological reasons, do not use the diaphragm in breathing as much as men do, can adopt this physiological adjuvant. Whether or not it is because of the abandonment of tightly laced corsets that I have had no difficulty in this respect, I do not know. At any rate, I have also the assurance of Prof. Joel E. Goldthwait of Boston, who has had a large experience with cases in which he prescribes diaphragmatic breathing in order to correct faulty conditions due to postural or typical orthopedic deformities in women, that he has no difficulty whatsoever in making his female patients use diaphragmatic breathing.

It may also be asked whether there are any contraindications to this type of breathing. If pain is caused by the diaphragmatic breathing or, if present, is accentuated thereby, it is a decided contraindication. The pain may be due to adhesions between diaphragm and pleura on the affected side, to an acute pleurisy elsewhere, or to an intestinal or peritoneal involvement. A further contraindication is that exceedingly rare condition in which the primary involvement begins in the lower lobes, or where the process has extended to that region in the terminal stage. Lastly, should cough be increased by this procedure, whether it can be explained or not, it should be considered a contraindication. The same holds good when an emphysematous condition causes additional discomfort.

The most satisfactory results from this physiological adjuvant to the rest cure in pulmonary tuberculosis can naturally be obtained in a sanatorium or hospital where the patients have come, so to speak, to occupy themselves with getting well. In a closed institution the tuberculous patient very often becomes depressed because of lack of employment and wishes he had something to do. With watch in hand or clock before him, he can occupy his time and help toward the cure by limiting his respiratory movements and giving rest to his lungs that they may have a chance to heal. However, satisfactory results can also be obtained in private practice. Here we have, more than anywhere else, the factors of personal equation. The family physican, having the absolute confidence of his

patient and knowing his peculiarities and state of mind, can often accomplish a good deal more where the psychic and nervous elements are involved than the institution physician. I have had private patients who became intensely interested in this procedure, and they were rewarded for their efforts by a gradual diminution of distressing cough, fever, and pleuritic pains. The more confidence and peace of mind and the more quiet and rest of body we can give the patient suffering with pulmonary tuberculosis, the greater will be our success.

Every student of tuberculosis knows that could he put to complete general rest every case of early tuberculosis, slightly febrile or afebrile and also limit completely, or if that is impossible, at least partially, the movements of the involved area, we would have considerably fewer advanced cases. In my early career I taught respiratory exercises as a prophylactic measure in tuberculosis and I do so still; but as a curative means, after observing the results obtained with artificial pneumothorax, I feel more than ever that anything which will put the inflamed lung, invaded by the tubercle bacillus, at rest, or even at comparative rest, is the ideal treatment.

For reasons above stated, I do not believe that artificial pneumothorax can be resorted to in all moderately advanced cases; still less do I believe that Jacobaeus's procedures or the thoracopneumoplastic operation will be frequently resorted to. Whether every early case of tuberculosis can or should be subjected to the treatment of artificial pneumothorax is still, as already stated, an open question, and the reason for this is perhaps that the results have not been as satisfactory as hoped for and that at times they were followed by unpleasant complications. But be that as it may, this simple physiological adjuvant can be resorted to without any risk whatsoever in both the early and later stages of the disease. When, in addition to the restricted respiratory movements, the patient trains himself to cough only when the accumulation of pulmonary or bronchial secretion demands it, he will be doubly benefited.

Dr. John W. Turner, the consultant in tuberculosis of the United States Veterans' Bureau, before whom I demonstrated the restricted and diaphragmatic breathing, thought that this method would not only secure local rest to the lungs, but also serve as an inspiration to the patient and give him something specific to do during his rest in bed or on the reclining chair while taking the cure.

Another colleague of mine in the U. S. Public Health Service, Dr. Nathan Barlow, said he felt convinced that this type of breathing would be conducive to quiet and serenity, psychic conditions most desirable in the rest cure of tuberculosis, but as a rule absent in the average patient.

Lastly, I submitted the paper in its present form to Dr. Lawrason Brown, one of the best known authorities on clinical tuberculosis in this country, who has been associated with the Trudeau Sanatorium for many years and a teacher at the Trudeau School since its establishment. In his reply he says: "I have read your article with a great deal of interest. I think it is an excellent idea and I shall put it into practice."

Besides this letter from Dr. Brown of Saranac Lake and another equally encouraging one from Dr. Julius Cone of the same town, I have since come into possession of very gratifying comments from many leading physicians in this country and abroad, all urging a most thorough tryout of this physiological adjuvant. Among the gentlemen who thus honored me, I wish to mention Drs. Frank Billings of Chicago, J. O. Cobb of the U. S. Public Health Service, Crile of Cleveland, Goldthwait and Otis of Boston, Krause of Baltimore, Minor of Asheville, Osborne of New Haven, Beverley Robinson, Neff and Stella of New York, Pattison of the National Tuberculosis Association, Dubé, Grenier and Le Sage of Montreal, Young of Toronto, Morton, Editor of The Tubercle of London, England, Prof. Tuffier of Paris, Prof. Saugman of Vejle Denmark and Prof. Rabinowitsch, Editor of the Zeitschrift für Tuberkulose of Berlin.

May I hope that this seemingly rational treatment will prove as successful in the hands of many as it has been in mine?

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DISCUSSION ON PAPER BY DR. KNOPF

Dr. John Ritter, Chicago: This paper by Dr. Knopf is most interesting, not so much from the standpoint of rest, but more so from the psychological viewpoint, ease of mind. Sometimes I wonder if we physicians, we practitioners in medicine, really realize what it means to our patients when we prescribe a medicine and tell the patient to take a teaspoonful every three hours. The long interval between hours is not considered to ease the patient's mind. In an adjoining room a similar case

is being treated by another physician, but instead of directing that a teaspoonful of the medicine be given every three hours he orders that five drops be given in water every ten minutes. The ultimate result, as to medication, in the two cases is precisely alike but with this difference, in the latter case during the three hours the patient's eye is constantly fixed on the clock dial, watching the time to take the next dose of medicine, and during all this the patient's mind is at ease, he forgets about his trouble. The physiologic adjuvant in the rest cure in pulmonary tuberculosis as advanced by Dr. Knopf is a most excellent one. Teach the patient how to breath, slow inbreathing, slow outbreathing, and a longer period of rest. By lessening the cycles of breathing, and giving the patient something to occupy his mind, there is produced a most beneficial influence on the psychology of the tuberculous.

Now as to the question of rest in tuberculosis. We physicians who are doing tuberculosis work well know the meaning, the importance of absolute rest in tuberculosis. When we are consulted in an active tuberculous case we institute absolute rest so long as we have high fever, pulse rapidity, etc., so long as there is evidence of progression, but the average physician, one who is not specializing, does not fully know the difference between absolute and relative rest in tuberculosis, and here we who are specializing in tuberculosis have a great responsibility. We must impress upon the family physicians the importance of absolute rest in active tuberculosis, teach them how to take care of this class of patients, for the average doctor is not at all familiar with what is meant by absolute rest in the treatment of pulmonary tuberculosis.

Dr. Wallace J. Durel, New Orleans: I happened to read Dr. Knopf's article a short time ago and we have tried the treatment in our sanatorium and I was greatly surprised how some patients manifested the control of respiration.

I would like to ask Dr. Knopf if he noticed any difference in the patient when lying upon the abdomen?

Dr. John W. Turner, Washington, D. C.: Dr. Knopf was kind enough to give me a demonstration of this method of treatment in the Fox Hills Sanatorium near New York. I haven't had an opportunity to try it out but I intend to do so if I have an opportunity.

Dr. Knopf: The position to which this type of respiration is best adapted is rather important. The patient should relax as much as possible while lying on his bed or on the reclining chair. The patient should of course always do this kind of breathing with chair or bed near the open window, or better yet, on a porch or a veranda. When combined with judicious hygienic, dietetic, and symptomatic treatment, I believe that the suggested adjuvant in the rest cure will be helpful.

THE DIAGNOSIS AND TREATMENT OF TUBERCULOUS EMPYEMA*

By Carl A. Hedblom, M.D.

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Tuberculous empyema may be defined as a type of suppurating pleurisy in which the tuberculosis bacillus is either the sole infective organism or is one of the organisms of a mixed infection. Dry adhesive pleuritis, pleurisy with serous effusion, and suppurative or hemorrhagic pleurisy constitute various grades of reaction to pleural infection. The extent of the pleural reaction is in proportion to the virulence of the infection and the resistance to it.

Positive proof of the tuberculous nature of a purulent exudate is afforded by finding the bacilli in the exudate, either by direct examination, or by animal inoculation, or by a demonstration of the characteristic microscopic picture in the excised pleura. Unfortunately it may be impossible to find bacilli on direct examination; the animal inoculation test requires at least six weeks' time and microscopic examination of the pleural tissue is a postoperative procedure. In the ordinary case, therefore, in which bacilli cannot be demonstrated in the exudate by direct examination, a presumptive diagnosis must be made on the clinical history of the case, the character of the exudate, and the recognition of a tuberculous process in some other organ.

A family history of tuberculosis is of some significance. Cabot showed that in a series of 300 patients with pleurisy, 67 per cent. who later developed tuberculosis had family histories of tuberculosis, while only 25 per cent. of those who remained well had such histories. An insidious onset without preceding infectious disease, especially if accompanied by fever, night sweats, loss of weight and strength, anorexia, and progressively increasing nervousness is always suggestive of tuberculous infection. The cases of insidious onset in apparently healthy, robust persons are among the most difficult to recognize. A history of preceding pleurisy with effusion, even though years before, affords grounds for suspicion that a later "idiopathic" empyema may be tuberculous. A history of pleurisy with serous effusion in an adult should be evaluated equally with that of hemoptysis (Lemon).

In cases without drainage, sterile, purulent fluid, especially with fever and a low leukocyte count, is almost certain to be tuberculous. The presence in other organs of a tuberculous lesion, notably phthisis or

* Read by title.

peritonitis lends weight to a presumptive diagnosis of the tuberculous nature of a co-existing empyema. A healed or quiescent pulmonary process such as is often seen in the roentgenogram, taken by itself, probably is of relatively little significance, but an active process giving rise to characteristic râles and especially with a positive sputum leaves little room for doubt with regard to the nature of an idiopathic purulent effusion. Effusion complicating artificial pneumothorax therapy, or following spontaneous pneumothorax in advanced cases, is probably tuberculous, even in the presence of pyogenic organisms which in such cases contribute to a mixed infection.

The records of the Mayo Clinic since 1910 contain histories of twenty-three cases, proved by bacteriologic and pathologic examination to be tuberculous empyema, and fifty-one cases in which a lesion elsewhere, or other clinical features, indicated at least a probable diagnosis of tuberculous empyema. Among the proved cases the diagnosis was made or confirmed by examination of the excised pleural tissue in eighteen. Guinea-pig inoculation of the exudate was positive in one case in the purulent stage, and in one in the serous stage. Necropsy in the latter case showed pyopneumothorax and tuberculosis of the lungs, liver, and retroperitoneal glands. Tuberculosis bacilli were found in smears of the purulent exudate in three. There were proved associated lesions, namely, Pott's disease with multiple "cold" abscesses in one case, positive sputum in one, tuberculous glands in one, and tuberculosis of the lungs and kidneys and perforation of a tuberculous intestinal ulcer in one. In thirty-eight of the remaining fifty-one cases in which a presumptive diagnosis of tuberculous empyema was made, an associated tuberculous lesion was present, shown by the roentgenogram in twenty-two, and by characteristic history and symptoms in sixteen. Of these sixteen a diagnosis of tuberculosis of the pleura was made from the gross appearance at operation in seven; in two of the remaining nine death was caused by the disease. In thirteen there was a history of a characteristic idiopathic pleurisy with effusion.

In the treatment of tuberculous empyema a distinction must be made between effusion in a closed pleural cavity and effusion in an open cavity. The exudate in a closed cavity may be sterile or infected secondarily; that in an open cavity is always infected secondarily.

Sterile effusion in a closed cavity may be serous, hemorrhagic, or purulent. The commonly accepted principle of treatment seems to be evacuation of all the fluids, by aspiration if the fluid is clear, and by rib resection and drainage if purulent. The latter is the method of choice often if the fluid is only turbid. This treatment is based on two fallacious assumptions, namely, that the presence of fluid is *ipso facto*, harmful and that a turbid or purulent fluid must be infected. Simple bacteriologic culture demonstrates that most of these exudates are sterile and there is evidence that a sterile exudate may exert a healing effect on a tuberculous process in the lung. Köniğer reports seventy-eight cases, in seventy-five of which marked improvement followed the appearance of effusion, and the im-

provement seemed lasting in more than half. Similar observations have been reported by Mongour, Schröder, Kaufmann, Muralt and others. Spengler and Sauerbruch point out that this does not seem to be due to the mechanical compression of the lung because the improvement observed is not in proportion to the amount of exudate. They believe the beneficial effect is owing to a biologic process of much importance. Königer attributes the improvement to a chemical process inducing an auto-immunization.

Aside from the possible beneficient influence of an exudate, its complete evacuation may exert a harmful effect on a co-existing incipient or active pulmonary lesion. Spengler says that miliary tuberculosis has been known to follow. Clinical experience has also shown that, whereas aspirating a large amount of fluid seems to stimulate further exudation, the aspiration of a relatively small amount promotes spontaneous absorption. Replacement of the fluid by filtered air or nitrogen seems especially desirable when the lung is actively involved and the exudate large in amount.

Patients with sterile purulent exudate are of the type most liable to become the victims of injudicious surgery. The condition represents an exception to the rule, *ubi pus, ibi evacue,* for the simple reason that there is no pus in the sense of the word used in this hackneyed phrase. Repeated aspiration and, if the effusion recurs, an extrapleural collapse constitute, in my opinion, the treatment indicated in these cases.

A mixed tuberculous and pyogenic infection in a closed cavity, especially with marked symptoms of sepsis, requires prompt drainage, either by the open or by the closed method. Irrigation by the closed method has the advantage that the cavity may be reduced in size and secondary reinfection prevented. The use of an irritating and especially a corroding fluid such as Dakin's solution seems, however, contraindicated in any case in which there is a well marked pulmonary lesion because of its corroding action on any superficial diseased area in the parenchyma of the lung which leads to bronchial fistula and possible hemorrhage.

The opening into the pleural cavity, in such cases, may be through the chest wall due to drainage operation or empyema necessitatis, or into the bronchus due to a ruptured tuberculous cavitation producing spontaneous pneumothorax. They all result in a mixed infection. Cavities following drainage vary from those in which there is little more than a sinus tract to those involving most of the pleural cavity. If the cavity is of long standing, the pleura is usually thickened. Anti-septic solution irrigation in such cases is safe and is usually followed by marked improvement of the patient's general condition. There may be very little thickening of the pleura, however, as in several instances in this series.

Tuberculous empyema with large bronchial fistula due to rupture of a cavitation into the pleural cavity may result in a virulent secondary infection, and is usually treated by wide incision, as irrigation with antiseptics is impossible. Drainage must be instituted in these cases. The

immediate mortality is high. Sauerbruch reports seventy-three cases, fifty-seven following pneumothorax therapy with 78 per cent. mortality.

For the purpose of obliterating a chronic persistent cavity a plastic operation is chiefly to be considered. Decortication of the lung by the Delorme-Fowler method is a questionable procedure. In the presence of an old extensive lesion the resulting pulmonary fibrosis probably precludes the possibility of reëxpansion. In case of an active lesion reëxpansion of the lung, even if possible, would seem undesirable. Furthermore, in some cases the pulmonary pleura is not thickened except at the periphery of the cavity and in other instances the whole surface is shriveled and wrinkled and so densely adherent as to make a separation of the pleura impossible.

TABLE 1

Types of Operation (Mayo Clinic Series)

	Aspiration	Exploration	Drainage	Decortication	Skin plastic	Skin muscle plastic	Schede's operation	Wilms' operation	Total
Group 1	13	5	16	5	5	4	4	3	55
Group 2	6	4	13	—	5	—	—	—	28
Group 3	1	8	18	1	1	3	—	—	32
Group 4	—	1	17	—	3	2	1	—	24
Total	20	18	64	6	14	9	5	3	139

TABLE 2

Sequence of Operative Procedure (Mayo Clinic Series)

Type of operation	First operation.	Second operation.	Third operation.	Fourth operation.	Total
Aspiration	17	1	2	—	20
Exploration	11	5	2	—	18
Drainage	41	17	4	2	64
Decortication	5	1	—	—	6
Skin plastic	4	8	2	—	14
Skin muscle plastic	4	4	1	—	9
Schede	2	2	1	—	5
Wilms	—	1	1	1	3
Total	84	39	13	3	139

A clear distinction must be made between an extrapleural rib resection (Estlander), (Boiffin-Wilms) and the radical resection including the parietal pleura after Schede. The extrapleural operation is especially indicated for the collapse of sterile undrained cavities. The Boiffin-Wilms graded thoracoplasty is especially adapted for the collapse of large cavities, particularly if the patient is of poor surgical risk. The radical resection should be reserved for cases in which the ribs are so fused and deformed and the pleura so thickened as to preclude complete collapse of the parietal pleura.

RESULTS OF TREATMENT

The type and sequence of the operative treatment at the Mayo Clinic is indicated in tables 1 and 2. In these tables insertion of a tube for aspiration and Dakin's solution irrigation is listed as aspiration. Drainage operations were, for the most part, rib resections. It will be noted that the decortication was performed with one exception as a primary operation. In these cases the diagnosis of tuberculous empyema was made after operation, from the excised pleura. Plastic resections were, as a rule, secondary procedures. The results grouped according to the operations are shown in table 3.

The patients who had several operations are grouped under the heading of the last operation or under the operation which is judged to have contributed most to the result obtained. It will be noted that the largest

TABLE 3

Results by operation

Operation	Cure	Good health, sinus.	Improvement.	No improvement.	Operative death.	Death later.	Total deaths.	Unknown.	Total.
Aspiration	—	—	1	1	—	1	1	—	3
Exploration	—	—	—	—	1	1	2	1	3
Drainage	9	5	8	2	7	9	16	6	46
Decortication	1	—	—	—	—	—	—	—	1
Skin plastic	3	2	—	—	1	3	4	—	9
Skin muscle plastic	3	2	3	—	—	—	—	—	8
Schede	—	1	—	—	1	1	2	—	3
Wilms	—	1	—	—	—	—	—	—	1
Total	16	11	12	3	10	15	25	7	74

TABLE 4

Results by Groups

	Cure	Good health, sinus	Improvement	No improvement	Operative death	Death later	Total deaths	Unknown	Total
Group 1	2	7	5	—	5	4	9	—	23
Group 2	2	3	2	—	3	4	7	2	16
Group 3	7	1	4	3	1	5	6	1	22
Group 4	5	—	1	—	1	2	3	4	13
Total	16	11	12	3	10	15	25	7	74

proportion of cures followed plastic operations. In the group in which a drainage operation only was performed, the high mortality is due to the relatively poor condition of patients.

The results are grouped according to the pathologic subdivisions in table 4. It will be noted that of sixty-seven patients in whom the end results are known, about 58.2 per cent. were cured, or much improved, 4.5 per cent. were not improved and 37.3 per cent. died. The postoperative mortality, deaths within two months after operation, was 14.9 per cent.

Of the twenty-three patients definitely proved to be tuberculous, 61 per cent. were cured, or greatly improved; 39 per cent. died. The postoperative mortality was 21.7 per cent. Fourteen of the sixteen patients with a clinical diagnosis of tuberculous empyema were traced; 50 per cent. were cured or much improved and 50 per cent. died. The operative mortality was 21.4 per cent. Of twenty-two patients with empyema associated with pulmonary tuberculosis, 57.1 per cent. were cured or much improved, 14.3 per cent. were not improved and 28.6 per cent. died. The postoperative mortality was 4.7 per cent. Of thirteen patients with empyema following pleurisy with effusion 66.6 per cent. were cured or improved; 33.3 per cent. died. The postoperative mortality was 11 per cent.

SUMMARY

1. Primary or idiopathic pleurisy with effusion, in a large proportion of cases, is probably tuberculous in nature.
2. A past history of pleurisy with effusion is common in cases of tuberculous empyema. In many cases the effusion is serous at the onset.
3. Tuberculous pleurisy may be primary, or it may be secondary to a pulmonary, peritoneal, or other tuberculous lesion.
4. The onset of a tuberculous effusion may be insidious or it may be sudden and associated with an acute and severe constitutional reaction. A mixed pleural infection due to the perforation of a tuberculous cavitation often runs an acute and rapidly fatal course.
5. Diagnosis of tuberculous empyema is made by demonstration of the bacilli in the exudate, by animal inoculation, or by examination of the sectioned pleura.
6. A sterile effusion is probably tuberculous. An infected effusion may be tuberculous.
7. Empyema following primary idiopathic pleurisy with effusion, or empyema of insidious onset, especially in the presence of a pulmonary or other tuberculous condition, is probably tuberculous.
8. Empyema may be tuberculous in spite of persistently negative findings over a long period of time.

9. In a closed pleural cavity a sterile effusion, whether serous or purulent, should not be treated by open drainage, except in the presence of an impending perforation of the chest wall.
10. Repeated aspiration of only part of the fluid present is indicated in cases of serous effusion producing definite dyspnea on exertion or symptoms of circulatory embarrassment.
11. The replacing of aspirated fluid by nitrogen or filtered air may be indicated in cases in which there are symptoms of active phthisis referable to the same side as the effusion.
12. A sterile purulent effusion should be treated as though it were serous if the lung expands when fluid is withdrawn. If the lung is fixed in a collapsed condition or if the effusion persistently recurs, an extrapleural plastic operation is indicated.
13. Effusion in a closed cavity showing a mixed infection should be treated by the closed method with antiseptic solution irrigation, or by open drainage; the open drainage is indicated especially in cases of severe infection associated with extensive pulmonary tuberculosis, making irrigation hazardous.
14. Tuberculous empyema with a large bronchial fistula should be drained by the open method.
15. A large tuberculous empyema with mixed infection from a previous drainage operation or from spontaneous perforation of the chest wall requires a plastic operation, preferably after treatment with Dakin's solution.
16. A plastic operation involving closure of a bronchus offers the only prospect of cure in case of an associated large bronchial fistula.
17. Dakin's solution irrigation may be contraindicated in the presence of an extensively diseased lung, owing to its corroding action on any superficial lesion, possibly resulting in hemorrhage or the formation of a bronchial fistula.
18. A plastic operation is usually eventually required in the case of closed cavities when the empyema is of long standing, and of all large, open, secondarily infected cavities.
19. An extrapleural rib resection is indicated for the collapse of closed sterile cavities. The Boiffin-Wilms operation is especially suitable for the collapse of large cavities without excessive thickening of the parietal pleura or rib deformity.
20. A skin or skin muscle plastic is indicated for the obliteration of relatively small cavities. Cases of long standing associated with greatly thickened pleura require an extensive resection of the entire chest wall after the method of Schede.
21. Operation in several stages is especially indicated in the treatment of tuberculous empyema, and, if practicable, it should be preceded by antiseptic solution irrigation. Such treatment should extend the indications for operation and should lower the postoperative mortality.

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THE DETERMINATION OF BODILY TEMPERATURE*

By Hugh M. Kinghorn, M.D.

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The success of rest and exercise treatment is very largely dependent upon an accurate observation of temperature. It is important, therefore, to consider the manner of taking temperature and its diagnostic significance.

When we take temperature solely as a control to treatment and not for diagnostic purposes, a two-hour temperature by mouth is sufficiently accurate. This should begin at 7 or 8 A.M., and continue until 8 P.M. Certain precautions are necessary to obtain correct results. The mercury bulb should be placed as far under the side of the tongue as possible, and not under the tip. Trained nurses and patients frequently put the thermometer under the tip of the tongue, and sometimes obtain an error of one-half degree F. or more. It is advisable also to leave the thermometer in the mouth for four minutes if a three-minute thermometer is used, and for three minutes if a one or two minute thermometer is used. The temperature should not be taken during or soon after a coughing spell, as coughing causes a temporary rise. It is, therefore, advisable, to wait for one-half hour after the coughing has ceased. It is also advisable to wait for one-half hour after drinking hot or cold liquids, and for one-half hour after meals. With the excellent one, two and three minute certified thermometers which we now possess, I see no reason why we should put the patient to the inconvenience of taking rectal temperatures, when we are taking merely routine temperature estimations. It is worth remembering that inflammations of the rectum may give high rectal temperatures, so also ulceration of the tongue may give high mouth temperatures. The temperature in the axilla is often higher on the diseased side with tuberculous and non-tuberculous pulmonary diseases than on the sound side. This fact is sometimes of diagnostic value.

When the patient has taken his temperature by mouth every two hours for a sufficient number of days, and has obtained a good idea of the temperature curve, we can allow him to take temperatures at 8 A.M., 2, 4 and 8 P.M.

In the diagnosis of pulmonary tuberculosis we should employ all possible accuracy, and should use, by preference, a two-hour rectal temperature throughout the day. It is only by doing this that we shall detect the slight oscillations that are present in incipient tuberculosis. These tem-

*Read by title.

peratures should be taken with the patient resting throughout the day, or at least not sooner than half an hour after being at rest, and should be taken in the reclining posture. A morning temperature of 36.9° C (98.4° F), and an after-noon of 37.4° C (99.3° F) may be assumed as a normal bowel temperature. In some patients it never rises over 37.° C (98.6° F) and amounts to only to 36.3° C (97.3° F)—to 36.5° C (97.7° F) in the morning.[1] The above mentioned limit is occasionally exceeded in women, due to the influence of the genital organs and the menses.

The course of temperature is frequently disturbed in pulmonary tuberculosis. The cases are very few in which the disease develops absolutely without fever. This may, however, disappear temporarily, so that the patient seems to be free of it during the investigation. V. Leube [2] and F. Moeller [3] are of the opinion that normal temperatures in incipient pulmonary tuberculosis are very rare. It frequently shows marked oscillations which are the expression of a particular susceptibility of the heat radiating centers. With the characteristic instability in tuberculosis the bodily heat increases about one degree or more on slight causes, such as after meals, after writing a letter, after washing and breakfasting in the morning—even if this is carried out in bed. It is a noticeable fact that these slight increases in temperature particularly when they occur after meals gradually diminish, and finally disappear as the patient gets well. Slight increases of temperature after meals and from, these other above mentioned causes should make us always suspect an active tuberculous focus. It is worth mentioning that with some very anaemic patients the first morning temperature is exceedingly low, and that the maximum of the day is less than 37.4° C (99.3° F) rectal (Brecke). It is therefore important to measure the temperature immediately after wakening. In other cases the thermometer shows a more even increase, which is independent of particular causes. This increase, which usually occurs during the afternoon, occasionally in the evening at 8 or 10 o'clock, reaches a maximum which is more or less above normal.[2] Occasionally large variations are entirely lacking, but the temperature is constantly somewhat increased and even in the morning is not below 37.° C (98.6° F). We sometimes see an inverted type of temperature—the typus inversus—and with such the prognosis is considered to be unfavorable. With this the maximum temperature is observed in the morning, and the minimum in the afternoon and evening. It is quite possible that these patients have temperature throughout the night, and that the high morning temperature is simply a hangover. These various forms of temperature speak very strongly for a tuberculous pulmonary disease. We must remember, however, that slight increases in temperature may appear in other diseases, such as chlorosis, ulceration of the stomach, pus deposits in the accessory sinuses of the nose, pyelitis, non-tuberculous bronchiectases, syphilitic liver diseases, inflammations of the female genital organs and the insidious infections proceeding from the tonsils. We must also consider the possibility of a purely nervous or hysterical fever. I very frequently

see young girls who are supposedly suffering from pulmonary tuberculosis. The physical examination and the x-rays fail to show signs of pulmonary disease, but these patients have a markedly disturbed sympathetic nervous system. Many of them have pronounced symptoms of hyperthyroidism. A considerable number have slight elevations of temperature, and some of them react very actively to a von Pirquet tuberculin test.[2] This of course only indicates that there is a tuberculous focus somewhere in the body, but does not indicate its site. The very active reaction, however, may perhaps signify a pathologically active focus of tuberculosis which may possibly be causing the symptoms.

As a sign of the instability of tuberculous temperature Penzoldt[4] found that it increases with otherwise fever-free tuberculous patients more strongly and more lastingly after a test walk of an hour than with healthy individuals, namely to 38.° C (100.4 ° F) and over (Penzoldt's symptom). This observation has been confirmed by others, but its diagnostic value is very much restricted because patients convalescing from acute diseases, chlorotics and obese patients show similar abnormal elevations after exercise. Penzoldt also mentions this. Temperature may also increase to 38.° C (100.4 ° F) after a short march.

In tuberculous and also in healthy women increases of temperature appearing before the menstruation are often markedly pronounced.[5] The temperature is rarely elevated during or after the menses. In tuberculous women this increase sometimes begins twelve or even thirteen days before menstruation.[2] Increased râles over the diseased lung, spitting of blood, and pleuritis frequently occur in association with it. These symptoms may quickly pass. In other cases the menstrual increase of temperature signifies the onset of a permanent and sometimes fatal relapse of the condition. These premenstrual increases of temperature in tuberculous women, and also in women who are suspected of having tuberculosis, often disappear as the patient gets well. The temperature of a woman who is suspected of tuberculosis should not be considered as normal until it has been thoroughly established before and during the menses. Absence of a menstrual increase does not exclude tuberculosis.

We should constantly remember that the temperature in old and extensive, as well as in beginning tuberculous processes, may show a completely normal course for weeks and months at a time. While, in most cases, the demonstration of fever is important for the diagnosis, yet its absence does not justify one in excluding the existence and progression of pulmonary tuberculosis. I have quite often seen patients in good physical condition and completely free from fever have a slowly progressing pulmonary phthisis.

Pronounced morning remissions of fever with high evening temperatures, accompanied by night sweats, frequently occur in serious and advanced cases of pulmonary tuberculosis. This is the hectic type of the disease, and signifies rapid destruction of tissue. Continued high fever appears chiefly in extensive pneumonic processes. In seeming health,

caseous pneumonias, disseminated broncho-pneumonias and peribronchitis, as well as acute miliary tuberculosis may set in with high fever, after material which contains tubercle bacilli has become disseminated through rupture into the air passages or blood-vessels of a tuberculous focus unobserved up until then. Should the rupture occur into a blood vessel an hemoptysis may occur, and there may be dissemination of disease over a large area of the lung.[2] In these forms of the disease the outlook is always very serious, and there is often a rapid termination.

Fever may also be caused or modified by mixed infection of the tuberculous lung by other pathogenic micro-organisms. Infections of the lung with staphylococci, pneumococci, influenza bacilli, streptococci and other pathogenic germs occasionally lead to an acute flare-up of a pulmonary tuberculosis which has been unobserved and slowly progressing until that time. The disease may only then be detected. Such infections may also interrupt the healing of a lung, or accelerate the destruction of a lung which has extensive disease. Every year we see numerous examples of the harmful influence which the influenza epidemics have on the course of patients with pulmonary tuberculosis. As a rule, however, it has not been established that other bacteria are more responsible than the tubercle bacillus for the fever of pulmonary phthisis. Sorgo[6] very correctly states that we should not see the work of foreign microorganisms in every acute exacerbation, in every intermittent fever, in every pneumonic focus, and in every cavity formation. "Though the pus producing organisms as a result of their rapid growth may produce pneumonic consolidations in which the tubercle bacillus does not participate at first, the resulting caseation is caused by the presence of the tubercle bacillus." Cornet.[7] In a case examined by A. Fraenkel[8] of disseminated tuberculosis with high fever as a result of haemoptysis, accurate examination was made at the post mortem for mixed infection, and no diagnostic point was found for it. Schröder,[9] Meissen,[10] and Kogel[11] have shown that chronic mixed infection is comparatively rare, and that no connection exists between the presence of pathogenic microorganisms in the sputum and a certain type of fever. If tubercle formation in pleurisy, peritonitis, meningitis with fever, is often associated with high fever, why should this be otherwise in the lung? Moreover, the fibrous form and the closed incipient cases do not usually course free from fever;[12] F. Moeller,[13] says that the tubercle bacillus may induce fever without mixed infection, and the caseous tissue degeneration, which is the basis for cavity formation, is, according to him, solely conditioned by the tubercle bacillus and its toxins.

We thus see how very important it is to get an accurate knowledge of the course of temperature. This is of the greatest value not only in the diagnosis but in the observation of the case.

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THE UPPER RESPIRATORY TRACT IN PULMONARY TUBERCULOSIS, WITH SPECIAL REFERENCE TO LARYNGEAL TUBERCULOSIS*

A Clinical Study of 200 Cases

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Of all the complications arising in the course of chronic pulmonary tuberculosis, the two most frequently encountered are affections of the upper respiratory tract, more particularly the larynx, and those involving the viscera below the diaphragm, chiefly the small and large intestines. In studying these two complications, one becomes impressed with the similarity existing between them, both as regards the frequency of their occurrence, the vagueness of the initial symptoms, the difficulty of making a positive early diagnosis, the protracted course with remissions and intermissions, and the great number of fatal terminations resulting therefrom. But inasmuch as the upper respiratory tract is more accessible to examination and accurate observation, it occurred to us that a study of the nose and throat in a given number of cases suffering from pulmonary tuberculosis might bring to light some additional information regarding the etiology, predisposing factors and frequency of laryngeal tuberculosis. It was also thought that such study might bring out the indications for treatment and the comparative value of the several methods now in common use.

An additional stimulus to this investigation was Fetterolf's[1] clinical postmortem study of the larynx in 100 cases in which he demonstrated 83 per cent. of tuberculous affections of one or more parts of the larynx and 4 per cent. as of doubtful involvement, making a total of 87 per cent. Such a percentage was considered unusually high. A study of living patients was therefore deemed desirable, to determine how it might compare with Fetterolf's observation on postmortem cases, since the majority of patients coming under our observation are of the far advanced active types.

This report is based upon a study of 200 cases, comprising 184 sanatorium patients and 16 tuberculous employees. As the average duration of sanatorium residence is nine months, that average was taken as the length of time the cases were observed.

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*From the Sanatorium of the Jewish Consumptives' Relief Society.

A few explanatory notes are necessary before tabulating the findings.

In studying the nasal chambers an attempt was made to determine the presence or absence of symptoms in cases showing abnormalities. Where the patient's statements could not be considered reliable, other methods were employed to determine to what extent a given pathological finding interfered with normal function. Thus a slight deviation of the nasal septum was not tabulated as abnormal unless it caused obstruction to breathing. On the other hand, where there was marked deviation, it was considered abnormal, regardless of symptoms. The same method was employed in classifying hypertrophic rhinitis, atrophic rhinitis, chronic nasopharyngitis, etc. Accessory sinus disease was determined by definite symptoms and physical findings; in doubtful cases roentgengrams were taken.

Hypertrophied tonsils were not classified as abnormal unless there was a definite history of frequent attacks of tonsilitis, and in those cases some crypts filled with cheesy matter could usually be located, particularly when the pillars were slightly separated. All tonsils showing definite lobulation or widely open crypts were considered abnormal.

In classifying the pathological changes of the larynx proper, attention was paid to the individual parts, but the aryepiglottidean folds and the vocal processes were omitted. The former were included with the arytenoid cartilages, for the majority of cases showing aryepiglottic involvement also had considerable involvement of the arytenoids. The vocal processes were included with the true vocal cords for the same reason. Ulcerations of the anterior portions of the vocal cords alone were rare; most of the ulcerations occurred in the vocal processes, including the posterior half of the cords. Superficial infiltrations were in most instances classified as granulations, for the reason that most of the so called superficial infiltrates were located in the interarytenoid sulcus posterior commissure, and there at least they were soft ulcerating granulations.

Continued observation of a case over a long period of time discloses that the earliest pathological manifestation arising in the interarytenoid sulcus, aside from congestion, is a median fissure or a lateral furrow as described by Casselberry[2]. Purulent secretions soon accumulate there and, becoming stagnant, give rise to irritation. The furrow gradually becomes wider as the free edges assume an edematous appearance. When the muco-pus is wiped away with a laryngeal applicator the floor of the groove is seen to be lined with irregular, red and eroded elevations which bleed readily. As time goes on, these elevations are seen filling the groove and overhanging the free edges. At this stage they constitute one yellowish-grey mass which does not bleed even when the muco-pus is removed with a dry applicator. On touching this mass with a curved probe it is found to be soft and almost gelatinous in consistence, and the probe can easily go down to the depth of the original groove. It was therefore felt that the term ulcerating granulation would be more

descriptive of the pathological change so frequently seen in the interarytenoid space.

In a few cases a circumscribed superficial infiltration was observed at the commissures or in the interarytenoid space, but it differed from the typical granular mass inasmuch as it was smooth, indurated, moderately congested and usually not ulcerated. Such induration might be considered the end result or the last stage of the granular mass when the latter finally heals and becomes fibrotic.

A definitely thickened epiglottis with or without ulcerations was classified as having a deep infiltration. Diffuse thickening of the arytenoids with obliteration of the normal landmarks made by the cartilages of Wrisberg and Santorini was also classified as deep infiltrates. The same standard was applied to the ventricular bands and true vocal cords.

Congestions alone were classified pathologically as being abnormal, although clinically they were not considered abnormal for the tuberculous. The anemias were put in a class by themselves for they could not be considered early manifestations of a tuberculous lesion. Even in those cases that showed no evidence of a general anemia, the anemic larynx could not be considered pathological, for continued observation showed no subsequent laryngeal changes.

Clinically the cases were divided into three groups: (1) tuberculous laryngitis, (2) doubtful tuberculous laryngitis, and (3) nontuberculous laryngitis and normal larynges. In the absence of ulcerations, a positive diagnosis was based upon diffuse infiltrates not yielding to ordinary treatment, or upon asymmetrical or localized swelling as pointed out by Levy.[3] The number of doubtful cases present in this series would tend to prove the conservatism used in making a positive diagnosis. It also points to the difficulty of making a differential diagnosis between chronic catarrhal laryngitis and chronic tuberculous laryngitis, a fact so well emphasized by Lockard.[4] Slight symmetrical thickening of one or more structures associated with congestion or small superficial erosions was put in the doubtful class. A small granulation in the interarytenoid sulcus without any other definite or suspicious lesions was considered doubtful, since a granulation alone was encountered in some nontuberculous or questionably tuberculous individuals.

Dworetzky's[5] classification was followed in describing the clinical types of laryngeal tuberculosis, and, in classifying the types according to stages, both Levy's and Dworetzky's work on this subject was followed closely. It must be noted, however, that the description of the types as well as the stages is more or less arbitrary, for the border-line was not often distinct. A chronic epiglottis was often seen associated with acute or subacute arytenoids or vice versa. The clinical impression was in many instances the determining factor in classifying the cases according to clinical types and stages.

Of the 200 cases, 126 or 63 per cent. had definite laryngeal tuberculosis; 44 or 22 per cent. were considered doubtful; and 30 or 15 per

cent. had nontuberculous laryngitis or normal larynges. Of the last 30, 25 had normal laryngeal structures, 1 anemia and 4 chronic laryngitis.

PREDISPOSING FACTORS OF TUBERCULOUS LARYNGITIS

1. Age: The youngest age was 17 and the oldest 70. The average age of all cases was about 30, a period when the ravages of tuberculosis are most frequent. Age therefore cannot be considered an important factor.

2. Sex: Thirty-six women were observed, and of these 24 or 66.6 per cent. had positive laryngeal involvement, 10 or 27.7 per cent. were of the doubtful class and 2 or 5.5 per cent. were normal. Of the 164 males 102 or 62.1 per cent. were positive, 34 or 20.83 per cent. were doubtful and 28 or 17.07 per cent. were normal or nontuberculous. The greater percentage of normals among males might be due to the greater number under our observation, but the fact that the percentage of positive laryngeal tuberculosis among women was nearly the same as among men despite the much smaller number of the former would tend to corroborate Duboff's[6] findings that sex is not a determining factor, and that external irritants, such as dust and tobacco smoke, play little rôle, if any, in the etiology of this disease.

3. Sputum: Of the 126 positive cases, 119 had positive sputum and 7 were negative; of the 44 doubtful cases 27 were positive and 17 were negative; and of the 30 nontuberculous cases 19 were positive and 11 negative. The theory of direct implantation of the tubercle bacillus into the mucosa and submucosa can therefore not be verified from these figures, nor completely disproved. The 19 cases that had positive sputum and negative larynx had pulmonary tuberculosis for a number of years, some even showing evidences of intestinal and genitourinary complications.

4. Cough: Cough as a mechanical factor in producing irritation of the laryngeal mucosa and thus rendering it more vulnerable to a tuberculous infection has been spoken of by many authors. In this series there were only 9 cases that had no cough or expectoration. Of these, 4 had tuberculous involvement of the larynx, 3 had doubtful involvement and 2 were not tuberculous. An effort to determine the extent of coughing by the amount of expectoration proved valueless, as many cases with excessive cough had less expectoration than those with moderate cough. Neither could much value be attached to the information obtained from the cases observed. Therefore, no definite deductions can be made as to the significance of cough in being a predisposing factor.

5. Pulmonary lesion: The National Tuberculosis Association nomenclature was employed, and the word minimal was substituted for incipient. Each stage was designated by the presence or absence of activity. The latter was determined by symptoms, physical signs and roentgengrams. An associated nonpulmonary tuberculous complication did not alter the classification.

Of the positive cases, 36 were moderately advanced, 25 active and 11 inactive; 87 far advanced, of which 84 were active, 3 inactive; and 1 had lung abscess and 1 asthma with no demonstrable tuberculous lesion. There was only 1 case with a minimal inactive pulmonary lesion associated with an inactive tuberculous enteritis. Among the 44 doubtful cases, 16 were moderately advanced, 6 active and 10 inactive; far advanced 25, all active; 1 with intestinal tuberculosis only and 2 with bronchiectasis and questionable tuberculosis. Of the 30 nontuberculous cases, 1 had a minimal inactive pulmonary lesion with intestinal tuberculosis; 14 were moderately advanced (8 active and 6 inactive); 13 far advanced, all active; 1 intestinal tuberculosis only; and 1 had asthma with no demonstrable pulmonary tuberculosis.

It can thus be seen that there were altogether 32 inactive cases, including the nonpulmonary and the questionably pulmonary cases; and of these, 21 had definite or suspicious laryngeal tuberculosis. Pulmonary activity, therefore, while usually associated with active laryngeal disease, is not an absolute factor. Striking examples of acute or peracute laryngeal tuberculosis with fibrosis of one or both apices have been observed. In fact, the most acute throat cases, not included in this series, have occurred in cases with inactive fibroid lesions, and it was in these particular types that most of the fatalities occurred.

As to the stage of the pulmonary disease, it will be noted that of the 68 moderately advanced cases 52 or 78.7 per cent. had a doubtful or positive laryngeal involvement, while of the 125 far advanced cases 112 or 89.9 per cent. had laryngeal affections. It would thus seem that the stage of the pulmonary affection is a predisposing factor that cannot be overlooked.

6. Pulmonary duration: The average duration of the pulmonary disease in all cases was 5.07 years. The pulmonary duration of the positive laryngeal cases was 4.33 years; of the doubtful cases, 5.27 years; and of the negative cases, 5.77 years. The average laryngeal duration was 2.27 years. This would indicate that 2.80 years elapsed from the beginning of pulmonary manifestations to the beginning of laryngeal symptoms. Levy, in a study of 654 cases, found that figure to be approximately 17 months. The discrepancy might be accounted for by a possible difference in the pulmonary stages of the two series.

7. Abnormalities of the nasopharynx: The theory that abnormalities of the nasopharynx, especially those giving rise to obstructive breathing, are predisposing factors of tuberculous laryngitis, is a plausible one; for it is easy to conceive how, when the normal function of the nose to moisten the air is diminished or totally absent, the inspired air will produce a dryness of the laryngeal mucosa, with subsequent formation of fissures and later ulcerations. The almost universal acceptance of this theory is evidenced by the frequency of operative interference for obviously prophylactic purposes. With a knowledge of the disastrous results that occasionally follow in the wake of an operation upon the nose

or pharynx in the tuberculous, it was thought that a careful study of the nasopharynx in relation to laryngeal tuberculosis will yield valuable information.[1]

In this series 72 or 36 per cent. showed no pathological changes, and 128 or 64 per cent. showed varying degrees of abnormalities. Of the 72 normals, 44 had laryngeal tuberculosis, 17 were doubtful and 11 were normal. From these figures alone no etiological relationship can be established.

The 128 cases showing pathology presented the following: Hypertrophic rhinitis, 32 or 16 per cent.; atrophic rhinitis, 17 or 8.5 per cent.; deviated septum, 46 or 23 per cent.; nasal polypi, 2 or 1 per cent.; diseased tonsils, 44 or 22 per cent.; spontaneous perforation of nasal septum, 2; post-operation perforations, 3; hypertrophic nasopharyngitis, 8 or 4 per cent.; pharyngitis Sicca, 18 or 9 per cent.; chronic ethmoditis, 3; chronic maxillary sinusitis and chronic frontal sinusitis, 2 each. These figures are decidedly at variance with those of Briggs[7] who found three-fourths of the tuberculous suffering from nasal stenosis. They also differ from those of Freudenthal[8] who, in a series of 340 patients, found 115 suffering from atrophic rhinitis. In our series the atrophic and hypertrophic forms were about equally divided, and the number of positive laryngeal cases was equally the same in each class. The greater number of cases of laryngeal tuberculosis in the series with nasal obstruction is only relative, considering the high percentage of positive laryngeal cases in the total series.

More definite deductions cannot be made in the absence of an analytical study of the nasopharynx in the same number of non-tuberculous individuals.

Frank tuberculosis of the nasal chambers, postnasal space or pharynx was not seen. Five very suspicious cases were noted; 3 in the anterior nasal chambers, 1 in the pharyngeal tonsil and 1 in the faucial tonsil. Several cases showed suspicious involvement of the uvala, and still others presented irregular elevations on the posterior pharyngeal wall; but, since no microscopic verification was made, a positive report would not be conclusive.

The pus from the several cases of accessory sinus infections was negative for tubercle bacilli, and the general clinical course seemed in favor of their not being tuberculous.

8. Syphilis: There were 5 laryngeal cases the serum of which was positive for syphilis. In none of these cases did the laryngeal lesion have any resemblance to lues. Two received specific treatment without any local improvement. In all, the local lesion was stationary.

PATHOLOGY

Only 5 acute cases were present; 1 in the first stage, 1 in the second stage and 3 in the third stage. Of the 49 subacute cases, 9 were in the first stage of the disease, 22 in the second stage and 18 in the third

stage. Of the 72 chronic cases, 9 were in the first stage, 32 in the second stage and 31 in the third stage.

For a detailed study of the character of the combined pathological changes of the several structures, reference has to be made to table 4 dealing with this subject. The pathological nature of the individual structures was as follows:

Epiglottis:

Deep infiltration and congestion	39
Deep infiltration and ulceration	6
Ulceration and marked destruction	2
Tuberculoma	2
Anemia	7
Anemia with infiltration	17
Infiltration with scarring	52
Congestion only	13
Infiltration	1
Normal	61

It can be seen that excluding the anemias and the congestions, 119 or 59.5 per cent. showed epiglottis involvement, while 52 or 26 per cent. showed evidences of a tendency to spontaneous healing. This is of prognostic significance, since epiglottis involvement is usually considered grave. This is indeed true where the condition is acute and ulcerations are extensive, but where there is a chronic or even a subacute infiltrate, the lesion may remain stationary for a long period and even terminate in a spontaneous cure.

The high frequency of epiglottis involvement in this series as compared to the findings of Dworetzky (28 per cent.) and Hastings[9] (33 per cent.) cannot be accounted for unless by assuming that our series contained a greater number of far advanced pulmonary cases with a longer pulmonary duration. It will be shown later, however, how close our findings are to those of Fetterolf's. That author found in his series 59 per cent. of epiglottic involvement.

Arytenoid cartilages:

Deep infiltration and congestion, bilateral	85
Deep infiltration and congestion, unilateral, right	2
Deep infiltration and congestion with ulceration	2
Deep infiltration and congestion with anemia	2
Deep infiltration and congestion with scars	2
Deep infiltration only, bilateral	13
Deep infiltration only, right	3
Deep infiltration only, left	2
Congestion only	15
Anemia alone	3
Normal	71

Excluding the anemias and congestions, the arytenoids were found clinically involved in 55.5 per cent. of all the cases. This figure compares

favorably with that of Dworetzky who, in a study of 100 positive laryngeal cases, found 56 per cent. arytenoid involvement, and also with the report of Hastings[9] whose figure was 51 per cent. This high frequency is generally attributed to the activity of the arytenoids in all respiratory acts, particularly coughing; but whether this association has any actual foundation cannot be satisfactorily answered.

Interarytenoid sulcus:

Deep infiltration and congestion	2
Infiltration only	28
Ulceration and ulcerating granulations	75
Fissures only	13
Anemia only	1
Normal	81

An analysis of these figures discloses that only 59 per cent. of the cases showed interarytenoid involvement, and is markedly at variance with the statistics reported by Keller, Carmody, Lockard[4] and others. The latter author found 714 of 904 cases with involvement of the interarytenoid sulcus. The decrepancy becomes the more difficult to explain in view of the fact that the interarytenoid space readily shows up in the laryngoscopic mirror, so that the slightest deviation from the normal can be easily detected.

That, however, does not detract from the well established fact that the earliest pathological manifestations of tuberculous laryngitis occur in the sulcus. The 10 early cases that came under our observation with vague symptoms presented only fissures or a small ulcerating granulation. But it was not uncommon to find extensive involvement of the epiglottis, arytenoids or vocal bands with a normal sulcus.

Vocal bands:

Deep infiltration and congestion, bilateral	12
Deep infiltration and congestion, right	1
Infiltration only, bilateral	43
Infiltration only, right	4
Infiltration only, left	3
Anemia, bilateral	1
Infiltration with scars, bilateral	2
Tuberculoma, bilateral	1
Deep infiltration with ulceration, bilateral	5
Deep infiltration with ulceration, left	1
Congestion, bilateral	3
Normal	124

The above shows that 36.5 per cent. showed involvement of the ventricular bands. Dworetzky found 27 per cent. in his series.

True vocal cords:

Infiltration and congestion, bilateral	57
Infiltration and congestion, right	2
Infiltration only, bilateral	7
Infiltration with ulceration, bilateral	3
Infiltration with ulceration, right	2
Infiltration with ulceration, left	8
Paresis, bilateral	1
Paresis, right	2
Paresis, left	4
Congestion only	33
Normal	81

From the above it is seen that, excluding congestions, 43 per cent. showed involvement of the true cords. As already indicated, vocal process disease alone was not seen. No relationship between cord involvement and pulmonary lesion was noted in those that showed a unilateral laryngeal process. This statement is also applicable to the other structures that were affected on one side.

A comparison of Fetterolf's postmortem findings with those noted in this series and classified as definitely tuberculous may prove instructive:

		per cent
Epiglottis	Fetterolf's	59
	Author's	55
Arytenoids	Fetterolf's	57
	Author's	51
Interarytenoid sulcus	Fetterolf's	51
	Author's	52.5
Ventricular bands	Fetterolf's	42
	Author's	32.5
Vocal cords	Fetterolf's	49
	Author's	37.5

Considering the greater number of doubtful cases in our series upon which no decision could be made by the use of the microscope, the slight difference in the figures is negligible. As was pointed out by Dworetzky, were it possible to make a section of each congested or slightly thickened epiglottis or arytenoid, there is no doubt that definite tuberculous disease could be demonstrated in nearly each case. The total number of our doubtful cases was 44 or 22 per cent., whereas Fetterolf's was only 9 per cent.

SYMPTOMATOLOGY

Among the positive cases, there were 103 with subjective symptoms. Of the 44 doubtful cases, 31 gave symptoms; and of the 30 nontuberculous cases, 25 of which had normal laryngeal structures, 16 gave symptoms. For the various combinations of symptoms reference has to be made to table 7. The leading individual symptoms were as follows:

Positive cases with symptoms (103)	Aphonia	2
	Dysphonia	61
	Dysphagia	28
	Pain	55
	Dryness	76
Doubtful cases with symptoms (31)	Aphonia	1
	Dysphonia	17
	Dysphagia	3
	Pain	12
	Dryness	29
Negative cases with symptoms (16)	Dysphonia	10
	Dysphagia	3
	Pain	5
	Dryness	8

From the above it is seen that dryness was the leading symptom in the positive and doubtful cases, and next in frequency was alteration in the voice, varying from marked hoarseness to a slight break in the voice during active conversation. The pain and dysphagia were often out of proportion to the amount of laryngeal involvement. Some cases with ulceration of the epiglottis or arytenoids had less pain than those with a slight infiltration of the arytenoids. Granular and ulcerating commissures gave, as a rule, no other symptoms than dryness and a frequent desire to clear the throat. The sensation of a lump in the throat was complained of by many, and here too a marked disproportion was seen between the symptoms and the extent of the swelling. Radiating pain to the ears was often an annoying symptom. A long interval of freedom from symptoms was often noted without any local improvement. The fact that 16 negative cases gave persistent symptoms characteristic of tuberculous laryngitis should be emphasized to prove that a diagnosis of tuberculous laryngitis upon symptomatology alone can not be made.

DIAGNOSIS

As has been stated in the introductory remarks, a diagnosis was based upon definite findings, such as circumscribed infiltrates, diffuse infiltrates persisting for a long time or ulcerations with or without soft granulations. In cases with associated syphilis the therapeutic test was used, and where no conclusions could be reached the case was considered doubtful. Simple catarrhal hypertrophies with a slight thickening of one or more structures were put in the doubtful class. Lesions in any way resembling lupus or pachydermia were not seen.

TREATMENT

All laryngeal cases classified as having been under no treatment used the DeVilbis atomizers containing either 1 per cent. of camphor and

menthol in alboline, Dobell's solution or other mild antiseptic sprays. The four types of active treatment were (1) formalin from 0.5 per cent. aqueous solution in ascending strengths up to 10 per cent., (2) lactic acid in either full strength or the 30 per cent. glycerine solution, (3) the electric cautery and (4) heliotherapy as perfected by Verba and described by Mills and Forster.[10] Only 31 cases were under active treatment and observed for a long enough period to justify a report. The indications for the use of formalin were subacute or chronic diffuse infiltration with congestion not subsiding under ordinary antiseptic sprays. Pure lactic acid was used for painful superficial ulcerations, and 30 per cent. lactic acid was used for superficial erosions and fissured commissures. The cautery was employed both in diffuse infiltrates where rapid shrinkage of the swelling was desired and in persistent local ulcerations. Heliotherapy was resorted to in cases suffering from extensive ulcerations or where the other methods failed. Silence as a therapeutic measure was urged in all active cases, but could be carried out satisfactorily in but a few cases.

Of the 5 cases under formalin, 2 were subacute, stage 2 and 3 respectively, and 2 were chronic, both stage 2. All these improved, as manifested by a decrease in the local swelling and the amelioration of symptoms. The one doubtful subacute case, stage 2, also improved. While this series contains only a small number under treatment in which careful records were kept, it must be stated that of the hundreds of cases treated with formalin only these 5 could be said to have definitely improved. Formalin as a detergent should be tried in all suitable cases, but where there is increased local irritation from its use, as is often the case, or where no improvement is seen in two or three months, it is best to resort to other methods.

The 7 cases treated with lactic acid were all definitely improved. The 2 doubtful cases, one with slight erosions of the epiglottis and the other with a fissure commissure, improved more readily than the positive cases. Here too it is realized that the statistics are incomplete, for while in this series only 7 were under lactic acid (all with good results), our records of other cases show that of 50 under similar treatment only 18 improved and the others remained stationary or became progressive. Of lactic acid, as of formalin, it may be said that it is a valuable therapeutic agent for erosions and superficial ulcerations, but where, after the separation of the eschar, the ulcer shows no tendency to epithelium formation; the actual cautery has to be used.

All the 18 cases treated with the actual cautery improved with the exception of one, and six showed definite healing. Exuberant granulations in the interarytenoid sulcus or early fissures cleared up more readily than large ulcers. Swollen arytenoids were seen to shrink to nearly their normal size in two weeks after deep multiple punctures with the cautery. The experimental observations on the effect of the electrocautery made by Wood[11] was well borne out in these cases. An actual scar resulting from the cautery was rarely reinvaded. An ulcer

with a sluggish base or pale granulations was seen to assume a red appearance during the course of healing. Only in the acute or peracute larynx with marked swelling of the epiglottis was the cautery of no value. An edema following its use was seen in one case. That case was of the acute type, stage 3, with marked edema of the arytenoid and thickening and ulceration of the right half of the epiglottis. It was thought that with the epiglottis previously cauterized, a shrinkage of the arytenoids might relieve the unimproved dysphagia and marked dyspnoea; but the effect was marked edema, necessitating local applications of cocaine and adrenalin to relieve the urgent symptoms.

No report can be made at present on the value of heliotherapy, since, of the 7 cases under treatment, 6 had been previously treated by the cautery method. The one case on heliotherapy alone, still under observation, is showing improvement.

Iodoglycerine in ascending strengths was tried on another series of cases without any other effects than those noted from ordinary antiseptic sprays.

The main interest in the report on treatment is the observation made on 139 cases under no treatment other than the use of tracheal oil, Dobell's solution, etc. In this group there were 98 positive cases and 41 doubtful cases. The types of lesions and the subsequent course can be seen from the following:

Positive cases	Subacute	Stage 2 (9)	Improvement	1
			Stationary	8
		Stage 2 (18)	Improvement	2
			Stationary	16
		Stage 3 (13)	Stationary	7
			Progressive	6
	Chronic	Stage 1 (9)	Improvement	4
			Stationary	5
		Stage 2 (28)	Improvement	11
			Stationary	17
		Stage 3 (21)	Improvement	8
			Stationary	11
			Progressive	2
Doubtful cases	Subacute	Stage 1 (9)	Improvement	2
			Stationary	7
		Stage 2 (16)	Stationary	16
		Stage 3 (3)	Stationary	3
	Chronic		Stationary	3
		Stage 1 (3)	Improvement	3
		Stage 2 (9)	Stationary	6
		Shage 3 (1)	Stationary	1

From the above is seen that in 139 cases under no treatment only 8 showed a tendency to progressive involvement, while 47 showed improvement and 92 remained stationary. Of the 8 progressive cases, 6 showed a progressive pulmonary lesion, while two were stationary.

SUMMARY AND CONCLUSIONS

The upper respiratory tract was studied in 200 tuberculous patients, in the moderately advanced or far advanced stages, with an average pulmonary duration of 507 years. Abnormalities of the nasopharynx were noted in 64 per cent. and nasal stenosis in 62 per cent., but the number of cases with positive laryngeal tuberculosis was not greater in those with nasal obstruction than in those with normal nasal chambers. Atrophy of the nasal mucous membranes was not a frequent manifestation and seemed to have no definite relation to laryngeal tuberculosis. Definite pathological changes of laryngeal structures were observed in 85 per cent.; and in 63 per cent. the laryngeal lesion was of such a type as to warrant a positive clinical diagnosis of tuberculous laryngitis. Five positive cases had associated syphilis, 2 of which received specific treatment without any demonstrable effect on the laryngeal lesions and the other 3 presented the characteristic lesions of tuberculosis. In 3 the lesion was subacute and stationary and in the other 2 the lesion was chronic and stationary. The quickest and most satisfactory results were obtained from the cautery. While all the active throat cases that were under the different forms of treatment improved, 139 cases under no treatment also improved or remained stationary with the exception of 8 whose lesion became progressive.

CONCLUSIONS

1. Laryngeal pathological changes are present in 85 per cent. of the tuberculous.
2. Laryngeal tuberculosis is present in at least 63 per cent. of the tuberculous.
3. Acute or peracute laryngeal tuberculosis is rare, the most frequent type being subacute or chronic.
4. There is no definite predisposing factor other than pulmonary tuberculosis.
5. Syphilis has no apparent influence on the course of laryngeal tuberculosis.
6. Subacute or chronic tuberculous laryngitis requires no active treatment in the absence of distressing symptoms, but must be under constant observation.
7. The presence of ulcerations even in the absence of symptoms is an indication for active treatment.
8. The galvanocautery is the best therapeutic measure for ulcerations or large infiltrates giving symptoms.

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[1], Consult table 3 for detailed study of nasopharynx.

TABLE 1

Classification of cases according to pulmonary diagnosis

LARYNGEAL DIAGNOSIS	MINIMAL		MODERATELY ADVANCED		FAR ADVANCED					INTESTINAL TUBERCULOSIS	BRONCHIECTASIS	ASTHMA	PULMONARY ABSCESS	TOTAL
	Active	Inactive intestinal tuberculosis	Active	Inactive	Active	Active with lues	Active with pulmonary abscess	Active with bronchiectasis	Inactive					
Tuberculous		1	25	11	79	3	1	1	2 1 with *lues*			1	1	126
Nontuberculous		1	8	6	13					1		1		30
Doubtful			6	10	23	1	1			1	2			44
Total	0	2	39	27	115	4	2	1	3	2	2	2	1	200

TABLE 2

Pathological classification of cases with laryngeal involvement

LARYNGEAL DIAGNOSIS	ACUTE			SUBACUTE			CHRONIC			TOTAL
	Stage 1	Stage 2	Stage 3	Stage 1	Stage 2	Stage 3	Stage 1	Stage 2	Stage 3	
Tuberculous	1	1	3	9	22	18	9	32	31	126
Doubtful				9	17	3	4	10	1	44
Total	1	1	3	18	39	21	13	42	32	170

TABLE 3

Study of the nasopharynx in 200 cases of pulmonary tuberculosis

LARYNGEAL DIAGNOSIS	NORMAL	ATROPHIC RHINITIS	ATROPHIC RHINITIS AND CRYPTIC TONSIL	HYPERTROPHIC RHINITIS	HYPERTROPHIC RHINITIS AND DEVIATION NASAL SEPTUM	HYPERTROPHIC RHINITIS AND CRYPTIC TONSILS	DEVIATION NASAL SEPTUM	ABSENCE OF SEPTUM AND TURBINATES	DEVIATION NASAL SEPTUM, CRYPTIC TONSILS
Tuberculous	44	8	3	8	6	2	14		4
Nontuberculous	11	2		2	0	2	3		3
Doubtful	17	3	1	2	0	2	4	1	2
Total	72	13	4	12	6	6	21	1	9

	SPONTANEOUS PERFORATION NASAL SEPTUM, CRYPTIC TONSILS	POSTOPERATIVE PERFORATION NASAL SEPTUM WITH DEVIATION	NASAL POLYPI	CRYPTIC TONSILS	HYPERTROPHIC NASOPHARYNGITIS	HYPERTROPHIC NASOPHARYNGITIS AND CRYPTIC TONSILS	PHARYNGITIS SICCA	PHARYNGITIS SICCA AND CRYPTIC TONSILS	PHARYNGITIS SICCA AND DEVIATION NASAL SEPTUM
Tuberculous	2	2	2	7	3	2	8	2	1
Nontuberculous		1		2	1			1	
Doubtful				6	1	1	1		3
Total	2	3	2	15	5	3	9	3	4

	PHARYNGITIS SICCA, SEPTAL DEVIATION, CRYPTIC TONSILS	PHARYNGITIS SICCA, POSTOPERATIVE SEPTAL PERFORATION, CRYPTIC TONSILS	CHRONIC ETHMOIDITIS	CHRONIC ETHMOIDITIS, SUBACUTE PHARYNGITIS	CHRONIC ETHMOIDITIS, POSTOPERATIVE, SEPTAL PERFORATION AND DEVIATION	CHRONIC MAXILLARY SINUSITIS	FRONTAL SINUSITIS	FRONTAL AND ETHMOIDAL SINUSITIS	TOTAL
Tuberculous		1	1	1	1	2	1	1	126
Nontuberculous	1					1			30
Doubtful									44
Total	1	1	1	1	1	3	1	1	200

TABLE 4

Pathology

	EPIGLOTTIS	EPIGLOTTIS ARYTENOIDS	EPIGLOTTIS BANDS	EPIGLOTTIS COMMISSURE	EPIGLOTTIS CORDS	EPIGLOTTIS ARYTENOIDS CORDS	EPIGLOTTIS ARYTENOIDS COMMISSURE	EPIGLOTTIS ARYTENOIDS BANDS	EPIGLOTTIS COMMISSURE BANDS	EPIGLOTTIS COMMISSURE CORDS	EPIGLOTTIS ARYTENOIDS COMMISSURE BANDS	EPIGLOTTIS ARYTENOIDS COMMISSURE CORDS	EPIGLOTTIS COMMISSURE CORDS BANDS
Superficial infiltration													
Deep infiltration	8	12	4	2		1	2	8		1	8	2	
Superficial ulceration													
Deep ulceration													
Superficial infiltration, ulceration													
Deep infiltration, ulceration. (1)				14	1	2	27	1	3	1	13	1	1
Total	8	12	4	16	1	3	29	9	3	2	26	3	1
A detailed study of ulcerated structures of larynx. (1)				Commissure 12 Com. Epig. 2	Cords 1	Left-Cord 2	Comm. 25 Com. Epig. 1 Com. Aryt. 1	Cords 1	Comm. 2 Com. Band 1	Cords 1	Comm. 16 Com. Band 2	Epiglottis 1	

TABLE 4—*Concluded*

Pathology

	EPIGLOTTIS ARYTENOIDS COMMISSURE CORDS, BANDS	ARYTE-NOIDS	ARYTE-NOIDS COMMIS-SURE	ARYTE-NOIDS BANDS	ARYTE-NOIDS CORDS	ARYTE-NOIDS COMMIS-SURE BANDS	ARYTE-NOIDS COMMIS-SURE BANDS CORDS	VEN-TRICULAR BANDS	BANDS COMMIS-SURE	COMMIS-SURE	CORDS	GRAND TOTAL
Superficial infiltration												0
Deep infiltration.....	2	3		6		3		1		1	1	65
Superficial ulceration.....												0
Deep ulceration.....										1		1
Superficial infiltration ulceration.....			3							5		8
Deep infiltration, ulceration	10		5		1	5	1	1	1	3		96
Total.....	12	3	8	6	1	8	1	2	1	10	1	170
	Comm. 2 All struct. 1 Epig. Com. Cords } 1 Com. Cords 4 Epiglottis 1 Epig. Cords 1		Comm. 7 Aryt. Com. } 1		Cords 1	Comm. 3 Com. Bands } 1 Bands	Cords 1					

TABLE 5

Pathological changes of individual structures of larynx

	EPIGLOTTIS	ARYTENOIDS	COMMISSURE	BAND	CORD
Deep infiltration and congestion	39		2		
Bilateral		85		2	57
Left					
Right		2		1	2
Congestion	13	15		3	35
Infiltration	1		28		
Bilateral		13		43	7
Left		2		3	
Right		3		4	
Anemia	7	3	1	1	
Thick—anemia	17	2			
Thick scarred	52	2		2	
Tuberculoma	2			1 Bilat.	
Ulceration			35		
Bilateral				3	3
Left				1	8
Right					2
Deep infiltration—ulceration	6	2			
Ulceration with marked destruction	2				
Granulation			26	2	
Fissure			13		
Granulation—ulceration			14		
Paresis					
Bilateral					1
Left					4
Right					2
Normal	61	71	81	124	81
Total	200	200	200	200	200

TABLE 6

Comparison of Fetterolf's postmortem study (100 cases) and authors' clinical study (200 cases)

LARYNGEAL DIAGNOSIS	GENERAL SUMMARY	EPIGLOTTIS	ARYTENOIDS	COMMISSURE	VENTRICULAR BANDS	CORDS
Authors' clinical study						
Tuberculous	126	110	102	105	65	75
Nontuberculous	30	61	71	81	124	81
Doubtful	44	29	27	14	11	44
Total	200	200	200	200	200	200
Fetterolf's postmortem study						
Tuberculous	83	59	57	51	42	49
Nontuberculous	13	37	43	49	57	51
Doubtful	4	4	0	0	1	0
Total	100	100	100	100	100	100

TABLE 7

Symptomatology

LARYNGEAL DIAGNOSIS	APHONIA	APHONIA, DYSPHONIA, DYSPHAGIA	APHONIA, DYSPHONIA, DYSPHAGIA, PAIN	APHONIA, DYSPHONIA, DYSPHAGIA, DRYNESS	DRYNESS	DRYNESS, PAIN	DRYNESS, DYSPHAGIA	DRYNESS, PAIN	DRYNESS, DYSPHONIA, DYSPHAGIA	DRYNESS, DYSPHAGIA, PAIN	DYSPHONIA	DYSPHONIA, DYSPHAGIA, PAIN	DYSPHONIA, DYSPHAGIA, DRYNESS, PAIN	PAIN	PAIN, DYSPHONIA, DRYNESS	PAIN, DYSPHAGIA	PAIN, DYSPHONIA	DYSPHAGIA	DYSPHAGIA, APHONIA, DYSPHONIA, DRYNESS, PAIN	TOTAL
Tuberculous	0	1	1	0	22	13	2	4	2	5	9	1	14	7	14	1	6	1	0	103
Nontuberculous	0	0	0	0	4	1	1	0	0	0	5	0	1	1	1	0	1	0	1	16
Doubtful	0	0	0	1	7	9	0	4	0	1	2	0	1	2	4	0	0	0	0	31

TABLE 8

LARYNGEAL DIAGNOSIS			TREATMENT OF TUBERCULOUS LARYNGITIS											RESULTS		
			Formalin	Formalin, lactic acid	Formalin, cautery	Formalin, heliotherapy	Formalin, cautery, lactic acid, heliotherapy	Lactic acid	Cautery	Heliotherapy	Heliotherapy, cautery	None	Total	Improvement	Stationary	Progressive
Tuberculous	Acute	Stage 1									1		1	1		
		Stage 2				1							1	1		
		Stage 3		1				1	1				3	3		
	Chronic	Stage 1										9	9	4	5	
		Stage 2	2						2			28	32	15	17	
		Stage 3		1			2		4	1	2	21	31	18	11	2
	Sub-acute	Stage 1										9	9	1	8	
		Stage 2	1	1	1				1			18	22	6	16	
		Stage 3	1		1			1	2			13	18	4	8	6
Doubtful	Acute	Stage 1														
		Stage 2														
		Stage 3														
	Chronic	Stage 1							1			3	4		4	
		Stage 2							1			9	10	4	6	
		Stage 3										1	1		1	
	Sub-acute	Stage 1										9	9	2	7	
		Stage 2	1									16	17	1	16	
		Stage 3										3	3		3	
Total			5	3	2	1	2	2	12	1	3	139	170	60	102	8

A TUBERCULOSIS SURVEY OF 1346 SCHOOL CHILDREN IN SASKATCHEWAN *

By R. G. Ferguson, M.D.

Fort Qu' Appelle, Saskatchewan

In July 1921, a Royal Commission was appointed by the Lieutenant Governor in Council, in Saskatchewan, to investigate the extent of tuberculosis in this Province. A tuberculosis survey of 1346 of the 170,000 school children in the Province was one of the tasks undertaken by the Commission.

The objects of the school survey were fourfold:—

1. To determine the incidence of tuberculous infection among the school children.
2. To discover as far as possible the sources of tuberculous infection in the areas selected.
3. To ascertain the prevalence of the pathological, economic and social conditions which would tend to develop tuberculous infection into tuberculous disease.
4. To find the frequency of tuberculous disease among the school children.

From the above objects you will see that the problem was approached from the preventive end, stressing incidence of tuberculous infection and the presence of pathological conditions that would contribute to the breakdown. The finding of cases of active disease was secondary and part of the larger plan.

Eight areas in the Province were selected as being representative and suitable for this investigation. Arrangements were made by the chairman of the Commission with the school boards for the survey in these areas. The parents were circularized and permission secured for complete examination of their children. Approximately two hundred children between the ages of 6 and 14 were selected for examination in each area. In all, 1184 white and 162 Indian children were examined. The examining team consisted of four nurses and two chest specialists whose services were required continuously throughout the survey, a dentist, and two eye, ear, nose and throat specialists, whose services were required for two days only in each area. The work was planned so as to commence the examination in an area on Monday and complete it within the school week.

* Read by title.

The examination consisted of two parts. A preliminary, or selective examination for the purpose of selecting suspects; and a final or diagnostic examination of all children selected as suspicious by the preliminary examination.

The principle of selection of cases was as follows:

All children received the tuberculin test and had an afternoon temperature and pulse taken. These were taken in the class rooms, the thermometer remaining in the mouth ten minutes. Those whose temperature was above 99.4 or who had a marked acceleration of pulse had both temperature and pulse checked the following afternoon. In the meantime the weight had been recorded and reduced to variation from normal; the teeth and tonsils had been examined by the specialists and findings recorded. The children appeared at the 48 hour interval to have the result of the first tuberculin test recorded; if negative, it was repeated. On this occasion the chest specialist palpated the cervical region for glands, and examined the child's chest for conformation, movement, venous arborization and evidence of winged scapulae.

The quantities in the problematic equation for the selection of suspect cases were then: 1, undernourishment; 2, elevated temperatures; 3, accelerated pulse; 4, glandular enlargement; 5, flat chest; 6, limitation of chest movement; 7, physical energy; 8, activity in sports; 9, tuberculin reaction. Taking into account these signs and symptoms, and making allowances for reaction in the case of focal infection and acute upper respiratory diseases, these cases were sifted down to those considered suspicious of tuberculosis, and the latter were selected for complete chest examinations. Out of the 1184 white children, 286 or 24 per cent. received a complete chest examination, and of this number, 46 had radiographs of chest taken.

INCIDENCE OF INFECTION AMONG SCHOOL CHILDREN

In order to find out the extent of tuberculous infection the tuberculin cutaneous test was used. This test was made on 1346 children in attendance at schools in eight representative areas in the Province and it was found that 56.6 per cent. showed signs of previous infection with tuberculosis. The incidence of infection among males was slightly higher than that found among females, being 57.1 per cent. in the former as compared with 54.9 per cent. in the latter. It was found from a study of incidence by age that 44.4 per cent. of the children were infected at the age of 6 years, the age at which the average child commences school. An increasing percentage reacted positively each year (excepting an irregularity at the age of 9 years) reaching 60.9 per cent. at the age of 14. It was found from the incidence by nationality that the Indian children showed a very high percentage of infection—92.5 per cent., compared with the average for other racial origins—54 per cent. The relation between incidence of infection and place of birth throws some light on the tuberculization of the Saskatchewan-born as compared with those

born in other provinces of Canada as well as with British born. The number of Europeans as well as Americans born in the area of the survey was not sufficiently large to justify a conclusion.

Place of Birth	Number of children examined	Per cent. infected
Born in Saskatchewan (including Indians)	845	58.9
Born outside Saskatchewan in Canada, Great Britain, Europe	501	54.9
Born in Canada, outside Saskatchewan	238	50.0
Born in British Isles	165	61.2
Born in United States	64	42.0
Born in Europe (France, Germany, Roumania, Russia)	34	52.0
Saskatchewan-born (not including Indians)	683	50.7
Saskatchewan-born Indians	162	92.5

The above figures would tend to show that tuberculous infection among Saskatchewan born white children is less widespread than is infection among the children of our immigrants as a whole, in proportion of 51 per cent. to 54 per cent., but slightly more widespread than among our immigrants from sister provinces, (in proportion of 51 per cent. to 50 per cent.)

Selecting a definite age group for comparison of the Commission's findings in Saskatchewan with those found in similar surveys elsewhere, we find the following:—

Survey	Number of children examined	Age group	Per cent. infected
St. Louis (Veedor & Johnson)	479	6-14	31.9
Vienna (Hamburger & Monti)	219	6-14	72.2
Saskatchewan	1254	6-14	56.4
Framingham	94	6-7	45.7
Saskatchewan	45	6-7	44.4
Vienna (Von Pirquet)	147	10-14	70.0
Saskatchewan	795	10-14	57.4

From the above it is evident that the school children of Saskatchewan are extensively infected with tuberculosis, although not so widely infected as those in the large City of Vienna. Nevertheless the degree of infection is higher than might be expected in a Province in which there are but small cities and a large rural population.

SOURCES OF TUBERCULOUS INFECTION

The investigation of the sources of tuberculous infection revealed the fact that 10 per cent. of the 1184 white children examined had a history of exposures in their homes at some time to persons suffering from

tuberculosis. The possibility of exposure in the community is suggested by the fact that in the representative areas from which the children examined were selected 753 persons died of the disease during the past four years. 488 of these died in their homes without having had a special training in the precautions necessary to be observed in order to protect others.

The result of tuberculin tests made on 3649 milk cows in the eight selected areas was as follows:—

In three of the areas where many of the cattle had been tested for several successive years 2791 tests were made and 3.8 per cent. reacted positively. In the five remaining areas where the cattle had not been previously examined, 858 milk cows were tested and 20.1 per cent. reacted positively. Four of the latter areas were rural and had no large dairy herd. The cows supplying milk to 470 children were examined and although but 18.3 per cent of these cattle reacted positively the milk from these reactors contaminated the milk supply of 224 or 47.6 per cent. of the children examined in these areas.

CONDITIONS WHICH MIGHT CONTRIBUTE TO THE DEVELOPMENT OF TUBERCULOUS DISEASE

From the survey made of the home conditions in the areas selected it would not seem that this could be considered an important factor. Home conditions were found excellent in 5.7 per cent., good in 84.8 per cent. and bad in 9.4 per cent.

Among the conditions found that would predispose to tuberculous disease, undernourishment was the most outstanding, 40.9 per cent. of the 1,346 children examined were 5 pounds or more underweight for height and age; 11.3 per cent. were five pounds or more underweight and classified as apparently thin by the medical examiners. The undernourishment, however, was not found to be directly accounted for by insufficient food, inasmuch as it was found almost as frequently among those with ample as among those with limited means.

Bad teeth was a condition found which would tend to lower resistance and contribute to the development of tuberculosis. Of the 1,346 mouths examined, 47.1 per cent. had one or more decaying permanent teeth. Bad prophylaxis and caries of teeth seemed to bear direct relationship to increased incidence of infection. In the above-mentioned group infection was found to be 13 per cent. higher among children with bad prophylaxis of the teeth, than among those with good, and 4 per cent. higher among those with caries than among those without caries.

Diseased tonsils was a condition present which would contribute to the breakdown. 25.3 per cent. of the children examined by throat specialists had diseased tonsils and 18.8 per cent. had excessive adenoid tissue.

A history of the acute infectious diseases from which these children had suffered, revealed the fact that before leaving public school 50.7 per

cent. had suffered from either measles, pertussis or influenza, and 16.3 per cent. has passed through a series of three or more acute infectious diseases. Only 49.3 per cent. escaped all acute infectious diseases.

FREQUENCY OF ACTIVE DISEASE

As a result of the survey it was found that among the 1,184 white children examined, 10 or .84 per cent. showed clinical signs, symptoms and x-ray evidence of active tuberculosis. These children were advised to take treatment in the Sanatorium. Thirty or 2.5 per cent. showed signs or symptoms more or less suspicious of activity. These children were referred to their family physician for observation.

FURTHER OBSERVATIONS ON THE TREATMENT OF DIABETES AND TUBERCULOSIS *

By H. R. M. Landis, M.D. and Elmer H. Funk, M.D.

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Several years ago we[1] presented before the Association some data with regard to the treatment of diabetes and tuberculosis, when these two diseases are associated in the same patient. An increasing experience has served to emphasize and expand some of the views expressed at that time. The association of these two diseases presents a particularly vicious combination to treat. At the outset one is confronted with the problem of the diet and these questions arise: (1) Should we ignore the diabetes, as was the common practice in the past, and treat the tuberculosis? or (2) Should we ignore the tuberculosis and endeavor to control the diabetes? Before we enter into a discussion of our attitude toward these questions let us consider briefly some elementary concepts of the two diseases.

Diabetes develops, as a rule, in a person who is over weight for his age and height. Diabetes, as Joslin puts it, is often the penalty of obesity, of overeating and underexercising. Diabetics usually have an excellent appetite and good digestion, but an inability to utilize carbohydrates, with its resulting hyperglycemia, glycosuria and other symptoms of the disease. Diabetics also have disordered protein and fat metabolism, and the inevitable result of the uncontrolled disease is wasting, reduced resistance to infection, coma and death.

Pulmonary tuberculosis, on the other hand, develops, as a rule, in those who are under weight for their age and height. Undernourishment and overexercise, that is faulty dietary factors and fatigue, play important etiological rôles. The appetite and digestion are frequently impaired.[2] There is no reduction in the ability to utilize carbohydrates, protein and fat, but the result of uncontrolled tuberculosis is like diabetes in the wasting, weakness and death.

At first glance it would seem rather queer that these two diseases with such diverse origins should ever be associated. It is our belief that they are more commonly associated than is generally considered. The question frequently propounded is: Which disease occurred first in the individual? It is our opinion that in practically all cases diabetes is the initial disorder and the active tuberculosis a subsequent development. Whether a latent tuberculosis is activated by the diabetes, or whether

* Read by title.

reinfection occurs as a result of disturbed metabolism, does not particularly concern us at this place. It is to the point, however, that the diabetes probably determines in most instances the development of tuberculosis in the person in whom both are found to be present.

If our elementary concepts of the two diseases are correct, it would therefore seem logical to give the treatment of the diabetes our first consideration, applying, at the same time, such measures as rest and fresh air, which are not incompatible with a strict diabetic treatment. Our experience has more than justified the attitude of ignoring, for the time being, the tuberculosis, as far as the diet is concerned, and of attempting to correct the hyperglycemia and render the urine sugar-free by the application of either the fasting method of Allen, of the gradual reduction method of Joslin, or even the high fat and low protein diet of Newburgh and Marsh. The inevitable result of the application of these dietetic restrictions is a loss of weight which to one interested in the tuberculosis is quite disconcerting. A loss of eight or ten pounds is not uncommon. Our reply to those who are concerned with this loss of weight is that it would inevitably occur if the diabetes was not controlled. Following such a loss of weight from treatment, it is possible to have a patient gain in weight to an extent that it is not possible in any other way. In others words, following dietetic restrictions, there is a gain in the patient's ability to utilize carbohydrates and properly metabolize fat and proteins, and with this improvement a chance not only for a gain in weight, but an increased resistance to further extension and activity of his tuberculosis. Increased resistance to the progress of the tuberculosis infection is a more important result of antidiabetic treatment than ability to gain weight. We are quite convinced, on more mature reflection, that in that particular group of tuberculous patients in whom diabetes is present, weight increases have less significance, as far as the improvement of the tuberculous condition is concerned, than in others, and this is in keeping with our knowledge of the prognosis of diabetes. The undernourished diabetic keeps well longer than one who tends rapidly to put on weight. The tuberculosis will improve even though there is no considerable gain in weight, if the diabetes remains under control at a given weight. The following case records are important in this connection:

Case 1. W. J. B., male, aged thirty-one years, referred by Dr. Joseph Walsh of Philadelphia and admitted to the Pennsylvania Hospital, January 12, 1922, and discharged March 30, 1922. *Family History*: Negative. *Past History*: Appendicectomy in 1911. Laparatomy for adhesions in 1913. Influenza in 1918. During 1921 he suffered frequently from painful hemorrhoids. *Present Illness*: Admitted on November 27, 1921, to St. John's Hospital, St. Louis, for operation for hemorrhoids. For three weeks prior to admission he had been annoyed by an "awful thirst" and the passage of much urine. He had also had for some time (he does not know how long) a slight cough with occasional expectoration. He had never had any blood spitting. For about four years he had noticed from time to time annoying pains in the left chest. The urine examination upon admission to the St. Louis hospital showed sugar and the examination of the sputum showed

tubercle bacilli. A diagnosis of diabetes and tuberculosis was made and the operation for hemorrhoids postponed. The patient was then referred to Dr. Walsh who confirmed the diagnosis of the two conditions. Dr. Walsh examined the urine upon a number of occasions and found from 5 to 12½ per cent. sugar. The patient's best weight was 180 pounds in 1913. From 1913 to October, 1921 he averaged 165 pounds. From October to November 27, 1921, the time of admission to the St. Louis hospital, he lost about twenty pounds, reducing his weight to the lowest level, that is, 145 pounds (the standard for his height, 5 feet 10¾ inches at age 31 is about 167 pounds).

Physical Examination: Upon admission to our hospital he was rather pallid and weak and showed signs of slight pulmonary involvement limited to the tops of the lungs. A few scattered râles were found at the right apex, but none on the left side. The heart was normal. The abdomen was normal. The extremities showed nothing abnormal.

Laboratory Studies: Blood chemistry studies revealed the following: Nonprotein nitrogen, 40 mgm.; urea nitrogen, 14.3 mgm.; uric acid, 2.5 mgm.; creatinin, 1.4 mgm., and sugar, 250 mgm. per 100 cc. The urine contained approximately 5 per cent. of sugar. The Wassermann test was negative.

Progress and Comment. Following three days of restricted diet and a fast of two days he became sugar free. Carbohydrates, proteins and fats were then added gradually from day to day without producing glycosuria, until a maximum of 220 to 230 gm. of carbohydrates, 105 to 110 gm. of fat and 86 gm. of protein were reached about one week before discharge. During this time his weight remained unchanged, oscillating from 140 to 144 pounds. His temperature remained normal during the entire period of observation except for four or five days when he had an acute cold. He gained remarkably in appearance and in strength. At first placed in bed he was subsequently given graduated exercise, until at the time of discharge he was up and about the greater part of the day and walking several hours. Physical examination upon discharge failed to reveal any moisture at the top of the right lung. We have every reason to believe that, barring accidents, this patient should remain well, especially since he is highly intelligent. While it is true that his pulmonary lesion was relatively insignificant, we feel that if his diabetes had not been promptly controlled, the probabilities are that it might have become a serious affair. During his hospital stay the patient was taught how to examine his own urine and from his own studies while under care had learned food values to the point where he was practically able to select his diet. Since his carbohydrate tolerance had been raised to such a high point, he could do this without the necessity of weighing the articles of food. This patient illustrates how an improvement can be brought about without weight gains.

Case 2. H. R., male, aged fifty-one years, admitted to the Jefferson Hospital Chest Department, November 27, 1921, and discharged February 25, 1922. *Family History*: Negative. *Past History*: He had always enjoyed good health until the onset of the present trouble in September, 1920. He stated, however, that five years ago sugar was accidently found in his urine during the course of a "health examination." A number of examinations subsequently made showed its continued presence. The patient tried dieting, with and without the advice of physicians, but apparently no serious attempt was made at any time to render the urine sugar free. *Present Illness*: In September, 1920, he caught a severe cold which was followed by cough and expectoration which continued to the time of admission to the hospital. A small hemoptysis occurred in February, 1921.

From January to April, 1921, he remained in bed. Between April and November, 1921, when he was admitted to the hospital, he was up and about the house, but unable to do any work. On November 18, 1921, just prior to his admission to the hospital, he had an acute pleurisy. He had received no treatment for the diabetes which had been ignored since the onset of the symptoms referable to the chest. His appetite and digestion have always been good. There has been no noticeable increase in the fluid intake or output. The patient was usually constipated. His best weight was 187 pounds in 1917 and his lowest weight 137 pounds at present. He believes that there was a definite loss of weight before the onset of his chest symptoms, although he doesn't know how much. He stated that he was "fat" in 1917 (the standard for his height and age at that time is 148 pounds).

Physical Examination and Laboratory Studies: A fairly well nourished adult with signs in the chest of moderately advanced disease of both lungs. The sputum was positive for tubercle bacilli, the urine showed 5 per cent., 4 per cent., 4.5 per cent. and 5 per cent. sugar during the first four days in the hospital. The Wassermann test was negative.

Progress and Comment: The patient was placed at rest in bed and after three days of restricted diet was fasted for two days, when he became sugar free. Carbohydrates, first in the form of green vegetables, coincidentally proteins, and finally fats were added and increased from day to day, always keeping in mind not to exceed the fatty acid-glucose ratio of 1.5 to 1. During the course of one month it was possible to reach a diet consisting of 115 to 120 gm. carbohydrates, 100 to 110 gm. of fat and about 90 gm. of protein, without glycosuria. During the early part of the treatment the weight dropped from 137 pounds to 126 pounds, and then as he was beginning to gain several pounds, the patient developed an abscess of the chest wall requiring incision. His weight dropped to 120 pounds. Following the incision and drainage of the abscess the weight returned to 125 pounds. Thereafter, from January 2nd to February 8th, when he left our care against advice, he improved very rapidly as far as both his diabetes and tuberculosis were concerned. He had reached a carbohydrate tolerance of 180 gm. daily. His temperature, which had been oscillating in the vicinity of from 100° and 101°, was practically normal during the last month of observation. His cough and expectoration had greatly improved. The signs in his chest, however, were unchanged. The patient felt so well that he refused to stay in the hospital longer.

Case 3. P. G., female, aged sixteen years, admitted to the Jefferson Hospital Chest Department, September 17, 1921, and continuing under observation (April 15, 1922). *Family History*: Father and mother have tuberculosis; one brother and one sister are in poor health, cause unknown. One brother and three sisters are living and well. *Past History*: Measles in early childhood. Pneumonia in February, 1916. *Present Illness*: About three months after the attack of pneumonia in 1916, from which she had apparently made a very satisfactory recovery, she began to cough, expectorate and lose weight and strength. These symptoms would clear up and return at intervals until February, 1918, when she visited a tuberculosis dispensary where a diagnosis of early, active pulmonary tuberculosis was made. At the same time the Wassermann reaction was found to be 4 plus and the urine was found to contain sugar. She was referred to the Pennsylvania Hospital for treatment, where she was admitted on June 10 and discharged on August 10, 1921, sugar free. Intensive arsphenamine therapy resulted in a negative Wassermann reaction. After her return home several lapses in the diet occurred and glycosuria developed with a return of the cough and weakness. She

was admitted to the Jefferson Hospital Chest Department on September 17, 1921. At this time the glycosuria varied between 1 and 2 per cent. and the fasting blood sugar 180 mgm. per 100 cc.

Progress and Comment The patient was placed at rest in bed and the glycosuria disappeared after a restriction in the diet for several days followed by one day of fasting. By the gradual addition of carbohydrates, proteins and fats, it was possible to obtain eventually a dietary consisting of 125 gm. of fat, 100 gm. protein and from 120 to 125 gm. carbohydrate. The weight upon admission was 99 pounds and after a slight loss there was a gradual gain to 113 pounds and then a drop to 106 pounds, which the patient has maintained on an average to the present time (April 15, 1922). The urine has remained sugar free and after the first month of the hospital stay the cough and expectoration practically disappeared. The temperature has continued normal and physical examination of the lungs reveals no evidence of moisture. The patient is allowed to be up and about the ward and on thirty minutes' walking exercise. The Wassermann reaction continues negative. This patient is particularly interesting, in view of the coexistence of three diseases, early pulmonary tuberculosis, latent syphilis and diabetes mellitus. They were recognized in this sequence by the physicians who saw her. If one can conjecture their order of appearance, it was probably syphilis (there are some features suggesting a congenital infection), diabetes and then tuberculosis. We feel quite certain that the intensive arsphenamine therapy and the antidiabetic treatment have given her the chance to combat the tuberculosis, which to date she seems to be doing satisfactorily.

It is not within the province of this paper to discuss the details of the dietetic management of diabetes, since the work of Joslin, Allen and others has made this a matter of common knowledge. There is a feeling however, among some sanatorium workers, that such treatment is not satisfactory or possible unless an elaborate equipment and a trained dietitian are available. We have found it entirely feasible where first, the physician is willing to give the intensive supervision necessary and second, the individual who prepares the food, whether a dietitian, so called or not, is willing to cooperate, and manifests an ordinary intelligence in the use of the Joslin food tables and the gram scales. After all, the interest of the physician in charge is the important factor in the success of the treatment.

It may not be remiss to speak a few words in regard to acidosis. We have never seen acidosis develop in a diabetic with tuberculosis under treatment when attention was paid to the proper adjustment of the carbohydrate, fat and protein of the diet. Those patients whom we have seen with acidosis had either not received any treatment before coming under observation, as was the case of one patient who died within a week after admission to the White Haven Sanatorium, with severe diabetes and hopelessly advanced tuberculosis, or else had failed to follow treatment while under observation or after leaving institutional care. A certain number of cases resulted from the attempt to push the fat in the effort to raise the calorie value of the diet. The fats are particularly dangerous. On the other hand, a certain amount of fat in the diet is necessary if the catabolism of the body fats is to be prevented. Woodyatt[3] has

recently insisted upon this and points out that unless the diabetic is obese, complete fasting is undesirable for desugarizing because it compels him to draw fat from his tissues. He states that the practice of starving, or virtually starving, a patient in order to render his urine sugar "free," and then building up the diet, first with carbohydrate and then with protein, with particular avoidance of fat, would appear to be based on the supposition that if fat were administered it would increase the catabolism of fat. Such a procedure disregards the endogenous food supply, and illustrates the necessity of thinking in terms of the metabolism rather than of the diet.

The important point in regard to the fats, therefore, is to know how to adjust the diet so that a maximum of fat may be given without disturbing the fat metabolism with the resulting formation of ketogenic substances and acidosis. As Woodyatt points out, all the foods which enter the body resolve themselves into either fatty acid or glucose. When acidosis develops it is the result of an imperfect oxidization of certain fatty acids as the result of the absence of a sufficient amount of oxidizing glucose. The ratio between fatty acids and glucose should not exceed 1.5 to 1. It follows, therefore, to quote Woodyatt,

> That the rationale of dietetic management in diabetes is to bring the quantity of glucose entering the metabolism from all sources below the quantity that can be utilized without abnormal waste; and to adjust the supply of fatty acids in relationship to the quantity of glucose so that in the mixture of food stuffs oxidizing in the body, the ratio of the ketogenic fatty acids to glucose shall not exceed limits compatible with freedom from ketonuria. When, as, and if, under these conditions of relative rest for the pancreas, the glucose using function improves, then the food supply may be increased gradually in so far as this can be done without disturbing the above relations.

It is of first importance, therefore, to know that a given quantity of carbohydrate yields in the body 100 per cent. glucose and no fatty acid; protein yields 58 per cent. glucose and 46 per cent. fatty acid, and fat yields 10 per cent. glucose and 90 per cent. fatty acid. With this information it is possible to calculate the diet, so that the ratio of fatty acids to glucose of 1.5 to 1 is not exceeded.

The determination of the glucose tolerance, or the amount of glucose which the body is able to utilize, is of the first importance in the effort to ascertain an optimal diet for a given individual. Heretofore is has been the practice to add small quantities of carbohydrate from day to day until sugar appeared in the urine. This is a slow method and it has been superseded by what is known as Woodyatt's optimal diabetic diet. For information as to the rapid estimation of this diet, the reader is referred to the recent article by O'Hara,[4] which also includes a convenient chart.

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Presented by title before the Clinical Section of the Eighteenth Annual Meeting of the National Tuberculosis Association, Washington, D. C., May 4-6, 1922.

THE DIAGNOSIS AND TREATMENT OF INTESTINAL TUBERCULOSIS

By Lawrason Brown, M.D., H. L. Sampson, and John N. Hayes, M.D.

Trudeau, N. Y.

Three years ago we described before this Association a method of diagnosis in intestinal tuberculosis, basing our conclusions on a study of 135 cases. Today we would like to place before you the results of a further study based on 1,036 cases, of which 323 (31 per cent.) were positive and 713 negative. Of these 945 were studied because intestinal tuberculosis was suspected clinically and 89 cases were studied routinely on admission to the Trudeau Sanatorium to determine the frequency of intestinal tuberculosis in cases of early pulmonary tuberculosis.

The method, as you will recall, is based on a fluoroscopic and radiographic study of a barium meal (barium 4 oz., flour, sugar, cocoa 1 oz. each in milk to 15 or 16 oz.) at the end of six, seven, eight and nine hours, and again at twenty-four hours. In certain cases a barium enema was used but, as we found in some definite cases it gave practically negative findings, we did not place as much dependence upon it as upon the meal. Hypermotility, localized or general, and filling defects were the most significant findings. Such data we believe indicate only ulceration of the colon which, when it occurs in a patient with pulmonary tuberculosis is practically always tuberculous in nature. Persistent and recurring segmentation and dilation of certain loops of the small bowel are very suggestive of a similar lesion in this location.

In the 89 cases at Trudeau which we studied routinely we found 5 cases to be positive. Several of these cases presented no symptoms suggestive of intestinal tuberculosis.

Of the Roentgen positive cases, 39 have been operated upon and 4 have come to autopsy. The findings in these have agreed with our diagnosis in all but one. In this case we attempted to base a diagnosis upon an apparent filling defect found in the transverse colon which is most unwise, for she had only a chronic appendicitis. Of the Roentgen negative cases, 24 have gone to operation and with two exceptions have been found negative. One of these had a tuberculous appendix with the disease extending into the cecum where there was a small ulceration. A "glorified" appendectomy removed all the diseased tissue. The second

* Read by title.

case was operated upon for probably chronic appendicitis but tuberculous colitis was borne in mind by Dr. Archibald (who also operated on the previous two cases). An extensive tuberculosis condition involving small and large bowel and the appendix was found and the abdomen was closed without further operative interference. Neither before nor since the observation has the patient shown any symptoms suggestive of intestinal tuberculosis. A very recent x-ray study was still negative.

Apart from these three cases all others, positive or negative by x-ray, were confirmed at operation or autopsy.

We feel less certain of the diagnosis of tuberculosis enteritis but in four cases at operation and one at autopsy in which we made a negative diagnosis of tuberculous colitis but a positive diagnosis of tuberculous enteritis operation or autopsy confirmed the x-ray finding. In our experience pulmonary tuberculosis is rarely complicated with tuberculous enteritis without the presence also of tuberculous colitis.

TABLE I

SUMMARY OF 1036 CASES

713 NEGATIVE	24 OPERATIVE	16 negative for tuberculous colitis 4 ileal. tbc. 1 tbc. salp.—peritonitis 1 tbc. appendix *1 cecal tbc., 1 ulcer. *1 extensive tbc. colitis
	2 AUTOPSY	1 ileal. tbc. 1 negative for tbc.
323 NEGATIVE	39 OPERATIVE	38 positive at operation 1 negative at operation
	4 AUTOPSY	4 positive at autopsy
ROUTINE SANATORIUM EXAMINATIONS 89	NEGATIVE 84	
	POSITIVE 5	

In a study of the blood of 35 of these patients we found a leucocytosis of 10,000 or more in 31, while one had 9,500 and three had between

6,000 and 7,000 leucocytes per cu.mm. The figures are given in Table 4. It is of interest to recall that studies of the blood in pulmonary tuberculosis by Ullum and Craig showed a definite leucocytosis in cases with cavity formation. Miller, Lupton and Brown in a later study found the most usual count to be between 10,000 and 11,000, with 24 to 28 per cent. of lymphocytes in early and moderately advanced stages to 14 per cent. in former cases.

It is of interest to note the low percentage of lymphocytes, which indicates also an absolute decrease of these cells. As far as we can determine treatment by ultraviolet rays seemed to exert little influence on our counts.

The primary object of our study was to discover a method by which we could diagnose early intestinal tuberculosis, for our early operative results were not satisfactory. We hoped that earlier diagnosis might lead to earlier and more successful operative proceedings. It is true that the technique of operation had been worked out on some of these cases and many to-day would not be considered as suitable for operation, or, if opened, would be closed without further interference. However, out of 16 cases early in the experience of one of us, 13 died; two early cases had successful complete resection of the cecum and part of the ascending colon and one with extensive disease had only his appendix removed. All have done well.

If we exclude those cases not studied roentgenologically and consider only those submitted to operation after such study, we find that out of 39 cases 25 have died. The operation at first was excision but the shock was too great and later, thanks to the untiring efforts of Dr. Edward Archibald, short circuiting was performed. But this in advanced cases often gave very unsatisfactory results. The production of an artificial anus subjects the patient to a prolonged ordeal. Today in extensive cases the best results will probably be obtained where the two ends of the tuberculous portion of the bowel are brought out through the abdominal wall in one or two operations and fistulae established.

Patients with pulmonary tuberculosis are never too good surgical risks and we have tried to develop other means of treatment. Like many other physicians, we have treated for years an occasional case of intestinal tuberculosis with heliotherapy but we were now confronted with many cases of early and late tuberculous colitis. In affording them treatment we were forced for several reasons to turn to artificial heliotherapy, which we had found of little or no avail for uncomplicated pulmonary tuberculosis. We have used the Mercury-Quartz vapor lamp which gives considerable ultraviolet ray and is so simple that the patient can apply the treatment himself. We have used daily treatment, beginning with the ankles, and with the lamp at a distance of 36 inches, increasing the exposures until we gave ten minutes over each of four fields including most of the body, with the lamp at a distance of twelve inches. Most patients tan, some more than others, and those who tan apparently do better than those who do not.

The results of such treatment depend directly upon the duration and possibly upon the extent of the intestinal tuberculosis. Early cases with definite x-ray findings may lose all symptoms and become negative by the x-ray after three or four months' treatment. Cases of longer standing require more time. Advanced cases in many instances show little improvement, for all resistance seems lost. In some instances we have been unable to give some of our poorer patients treatment with ultra-

TABLE 2

RESULTS OF TREATMENT OF 146 CASES OF PULMONARY TUBERCULOSIS, WITH TUBERCULOUS COLITIS

FORM OF TREATMENT.	LIVING.		TOTAL	DEAD		TOTAL	GRAND TOTAL
	S. L.	TRUDEAU		S. L.	TRUDEAU		
Hygienic, dietetic and drugs	5	8	13	22	9	31	44
Operation.	3	1	4	8	6	14	18
Ultraviolet.	38	21	59	16	3	19	78
Ultraviolet and X-ray	5	1	6	0	0	0	6
	51	31	82	46	18	64	146

TABLE 3

RESULTS IN LIVING CASES.

FORM OF TREATMENT.	TOO SHORT TIME.	QUESTIONABLE	SLIGHT IMP.	FAIR IMP.	GOOD IMP.
Hygienic, dietetic and drugs	1	4	—	3	5
Operation.	—	—	—	—	4
Ultraviolet.	7	6	6	7	33
Ultraviolet and X-ray	—	2	—	2	2
	8	12	6	12	44

TABLE 4

NUMBER OF LEUCOCYTES.

TOTAL.	NO. OF CASES.
6 - 7,000	3
9 - 10,000	1
10 - 15,000	12
15 to 20,000	14
20 to 30,000	5
	35

violet ray and these we have subjected to x-ray treatment employing as an average dose: 5 milliampere minutes, 90 Kilo-volts, 2½ to 3 milliamperes, filtration with 5 milliamperes of aluminum, tube skin distance 35 c.m. The results here too have been striking in some cases. As a usual thing, however, we have resorted to Roentgen therapy only when the ultraviolet lamp failed to yield the desired results. Consequently we have usually combined these treatments and obtained some satisfactory results.

It must not be forgotten that some cases of intestinal tuberculosis do recover under the ordinary hygienic and dietetic treatment but in our experience such recoveries are rare. We have attempted to control the effect of the ultraviolet light by single exposure of the skin to a high candle power Mazda nitrogen filled daylight bulb.

We wish to thank Dr. Archibald and our colleagues in Saranac Lake who have permitted us to use the results of the study of their cases.

THE EFFECT OF SIX WEEKS' BED REST UPON PATIENTS ENTERING TRUDEAU SANATORIUM*

By Lawrason Brown, M.D., and F. H. Heise, M.D.

Trudeau, N. Y.

With a feeling that intensive bed rest for a period of six weeks would benefit all cases of pulmonary tuberculosis at the outset of treatment, regardless of symptoms, two cottages were set aside at the Trudeau Sanatorium as "Rest Squad Cottages." As far as possible, those on the waiting list having a more recent onset of disease, but irrespective of extent, were selected to undergo this special rest treatment. All others were admitted in the regular way and had the usual but no intense rest treatment, except for acute illness. These cases are later designated as "No Rest Cases."

After being admitted to the "Rest Squad" the patients were put to bed for a period of six weeks. Meals were served at the cottages and the patients were allowed to eat at a common table in their bathrobes. After six weeks of bed treatment the patients were allowed to become ambulant as follows: For the first day, one meal was taken at the main dining hall, two minutes walking distance. On the second day the patient remained at the cottage. If all went well he was allowed to go to one meal on the third and fourth days. On the fifth day he was allowed to walk to two meals and on the sixth day to only one. On the seventh and eight days he was permitted to walk to two meals. On the ninth day, three meals at the main dining room were allowed; on the tenth day, two and on the eleventh and three subsequent days, three. After this the patient was transferred to another cottage. Of course if there were any contraindications for walking, the patient remained in bed.

While at the cottages, the patients were under the supervision of a nurse. Temperature, pulse and other records were kept daily. Weighing was done once weekly, and once weekly, also, conferences of patient and physician were held. At these conferences the patients inquired into the why's and wherefore's of treatment, the nature and prognosis of the disease in general, and they were advised regarding changes in mode of living and future care of themselves.

* Read by title.

In all, 161 cases were treated in the "Rest Squad" and 629 cases otherwise. The following table shows the diagnosis of these cases:

TABLE 1

	REST CASES		NO REST CASES	
	NUMBER	PER CENT	NUMBER	PER CENT
Non Tuberculous	13	15	92	8
Suspected Tuberculosis	9	5	29	6
Minimal	19	13	84	12
Moderately advanced	99	55	349	61
Far Advanced	21	12	75	13
Total	161	100	629	100

In 80 per cent. of the "rest" and 47 per cent. of the "no rest" cases, treatment preliminary to entrance to the sanatorium was taken for one month or less. In the "rest" cases, preliminary treatment ranged from a few days to eleven and a half months, and in the "no rest" cases, from a few days to twenty-four months.

Treatment in the sanatorium lasted for the "rest" cases, from one and a half to twelve months, and for the "no rest" cases, from one to seventeen months. Five and six months' residence occurred in 49 per cent. of the "rest" and 40 per cent. of the "no rest" cases.

Preliminary and sanatorium treatment combined lasted seven months or less in 76 per cent. of the "rest" cases and 64 per cent. of the "no rest" cases. So that on the whole the "no rest" cases had a somewhat longer period of total treatment at the time of discharge. The "rest" cases had, on the average, one month less treatment than the "no rest" cases.

All cases were subdivided according to diagnosis, and further subdivided according to character and extent of the x-ray lesion. Analyses of the cases were then made with the following points in mind:

1. Discharge condition, viz., apparently arrested—quiescent—improved —unimproved.
2. Changes in x-ray findings, i.e., increase, decrease or no change in extent or intensity of the lesion at discharge, compared to entrance.
3. Increase, decrease, no change or development of râles, when comparing discharge and entrance examinations.
4. Occurrence, persistence or disappearance of tubercle bacilli.

Non-tuberculosis and suspected tuberculosis cases were not considered in the final analysis, which showed that practically no difference existed in the "rest" and "no rest" groups. The results were as follows:

1. In regard to the condition at discharge, the maximum variation in the two groups was not over 4 per cent., which occurred in favor of the "rest-improved" group.

2. In regard to x-ray changes noted at discharge, the maximum variation in the two groups was not over 7 per cent., which occurred in favor of the "rest-x-ray-decrease" group.

3. In regard to râle changes noted at discharge, the maximum variation in the two groups was not over 6 per cent., which occurred in favor of the "no-rest-no-râle" group.

4. In regard to the occurrence of tubercle bacilli, the maximum variation was 5 per cent., which occurred in favor of the "no rest-no bacilli" group, i.e., 5 per cent. more of the "no rest" than of the "rest" group never had tubercle bacilli.

CONCLUSIONS

While no striking evidence is produced to show the benefit of six-weeks' bed rest to cases entering the Trudeau Sanatorium under the conditions existing relative to selection of cases and time of beginning treatment, the authors nevertheless feel that under more favorable conditions, especially when treatment can be begun immediately upon diagnosis, intensified bed rest will prove of benefit to the patient, although symptoms of definite activity are absent. Surely a much more impressive idea of the seriousness of the disease and of the necessity of proper care is inculcated and this should, in later days, months or years, show beneficial results in prevention of relapse.

A STUDY OF THE OCCURRENCE OF HEMOPTYSIS, PLEURISY, RÂLES, TUBERCLE BACILLI AND X-RAY FINDINGS IN ONE THOUSAND CONSECUTIVE CASES ADMITTED TO THE TRUDEAU SANATORIUM*

By F. H. Heise, M.D., and Lawrason Brown, M.D.

Trudeau, N. Y.

One thousand cases entering the Trudeau Sanatorium were analyzed to determine the frequency of hemoptysis, pleurisy, râles, tubercle bacilli and parenchymatous x-ray lesions in those cases subsequently diagnosed as tuberculous and non-tuberculous. It was hoped that this analysis would reveal to us some basis from which diagnostic criteria could be evolved making the diagnosis of tuberculosis conform to certain standards, without which the diagnosis would always at least remain in doubt.

While nearly all cases had previously been diagnosed as pulmonary tuberculosis, a few were sent to the sanatorium to prove or eliminate this disease. No attempt was made to select the cases from the waiting list for admission, so that the analysis represents fairly accurately the ordinary run of cases admitted to the Trudeau Sanatorium, viz., minimal and moderately advanced cases.

Of the 1,000 cases, 815 were diagnosed as having pulmonary tuberculosis and 185 as suspects or non-tuberculous. These 185 will later be grouped under the one heading "non-tuberculous." All cases having had hemoptysis of a teaspoonful or more and all cases having had pleurisy with effusions were diagnosed as tuberculous in this analysis, although undoubtedly some were not.

The analysis of the cases, (table 1) revealed the occurrence of:

1. Hemoptysis of a teaspoonful or more in 246 cases of the tuberculous (30 per cent.).
2. A history of dry pleurisy or pain in the chest in 470 tuberculous (57.6 per cent.) and 141 non-tuberculous (76 per cent.).
3. Definite fine, moderately coarse or coarse râles in 608 tuberculous (74.6 per cent.) and 50 non-tuberculous (27 per cent.).
4. Tubercle bacilli previous to admission to the sanatorium in 124 tuberculous (13.9 per cent.) and tubercle bacilli in the sputum while at the sanatorium in 459 tuberculous (55 per cent.).

* Read by title.

5. No demonstrable pulmonary lesion by x-ray examination (Neg. x-ray) in 6 tuberculous (0.7 per cent.) and 22 non-tuberculous (12.4 per cent.).
6. A peribronchial type of lesion by x-ray (Pb.) in 74 tuberculous (9 per cent.) and 163 non-tuberculous (87.6 per cent.).
7. A parenchymatous type of lesion by x-ray (Pc.) in 735 tuberculous (90 per cent.).

Accepting the theory that all hemoptyses are due to pulmonary tuberculosis the absence of hemoptysis certainly does not preclude this disease, since only 30 per cent. of the earlier type of case (minimal and moderately

TABLE 1.

Occurence of Hemoptysis, Wet Pleurisy, Rales, Tubercle Bacilli, and X-ray type in 815 Tuberculous and 185 Non-Tuberculous

		Tuberculous			Non Tuberculous	
		No.	%		No.	%
Wet Pleurisy		47	5.7		0	
Hemoptysis		246	30		0	
Rales		608	74.6		50	27
Bacilli	Prev. Only	124	13.9		0	
	Resid.	459	55.		0	
Neg. X-ray		6	0.7		22	12.4
Pb. X-ray		74	9		163	87.6
Pc. X-ray		735	90		0	
Dry Pleurisy or Pain in Chest.		470	57.6		141	76

advanced) had this symptom. In the positive sense this symptom is of course valuable. A history of pleurisy or pain in the chest when not

definitely accompanied by pleural friction is of no value as a diagnostic symptom, since it occurs as often or more often in the non-tuberculous. The presence of râles, however, is of importance as 75 per cent. of the tuberculous had them and only 27 per cent. of the non-tuberculous. Of course râles occur in other non-tuberculous pulmonary conditions. The presence of tubercle bacilli in the sputum naturally makes the diagnosis. When no parenchymatous infiltration is seen in the x-ray film or plate, pulmonary tuberculosis is not likely to be present (10 per cent.) whereas most of the cases with pulmonary tuberculosis (90 per cent.) show a definite parenchymatous x-ray lesion.

Not considering the symptoms of toxemia from the diagnostic standpoint, it would be fairly safe to say that all cases of pulmonary tuberculosis should have one or more of the following diagnostic criteria brought out in their examination:

1. Tubercle bacilli in the sputum.
2. A history of hemoptysis or pleurisy with effusion.
3. Râles.
4. Parenchymatous x-ray lesion.

A further analysis was made to see to what extent hemoptysis, pleurisy, râles and tubercle bacilli were associated with the various types of lesions as seen on the x-ray (Neg. Pb. Pc.). Table 2 shows the result of this analysis in detail. Briefly, it may be stated that 470 of 611 cases (77 per cent.) with dry pleurisy or pain in the chest, showed a parenchymatous x-ray lesion. Wet pleurisy occurred in 47 instances, 30 of which (64 per cent showed a parenchymatous lesion. Hemoptysis occurred in 246 instances of which 220 or 89.4 per cent. showed parenchymatous lesions. Confirming somewhat the belief that 90 per cent. of hemoptyses occur in pulmonary tuberculosis. Of 658 cases having râles, 589 or 89.5 per cent. showed a parenchymatous lesion. This is another interesting occurrence. It was of great interest to find that 97.4 per cent. (447 of 459 cases) of cases having tubercle bacilli in the sputum while at the sanatorium had a parenchymatous lesion. The remaining 2.6 per cent. showed a peribronchial type of lesion. Thus when tubercle bacilli are present, the x-ray will almost invariably reveal a lesion.

From the above it may be said that a definite parenchymatous lesion was demonstrated in the x-ray plate or film in:

1. Almost all who had positive sputum (97.4 per cent.).
2. Nine out of ten cases with râles.
3. Nine out of ten cases having had hemoptysis.
4. Nearly eight out of ten cases having a history of dry pleurisy or pain in the chest.
5. Six out of ten cases with pleurisy with effusion.

Table 3 shows the character and location of the râles heard, together with the type of x-ray lesion with which they were associated. It is of interest to note that parenchymatous lesions are associated most often with the moderately coarse râles found in the upper one-third or more of the same lung, (98 per cent. of 425 such cases). Next in frequency were moderately coarse or fine râles heard in the middle of the lung only (88.5 per cent. of 26 cases). Fine râles in the upper third or more of the same lung came next in frequency (80 per cent. of 120 cases). Fine râles in the upper third of the lung with moderately coarse râles at the base were much less frequently associated with parenchymatous lesions (65 per cent. of 20 cases). And basal râles only, least frequently of all (58.2 per cent. of 67 cases). In some cases, the occurrence of râles was somewhat in doubt. Of these, 52.8 per cent. of 36

TABLE 2

Occurence of Pleurisy, Hemoptysis, Rales and Tubercle Bacilli in the Negative, Peribronchial & Parenchymatous X-ray groups (1,000 cases)

	No. of Cases	Neg. X-ray 28		Peribronch 237		Parenchy 735	
		No.	%	No.	%	No.	%
Wet Pleurisy	47	0		17	36	30	64
Hemoptysis	246	6	2.4	20	8.1	220	89.4
Rales	658	7	1	62	9.4	589	89.5
Bacilli	459	0		12	2.6	447	97.4
Dry Pleurisy or Pain in Chest.	611	12	2	129	21	470	77

cases had parenchymatous lesions whereas only 41.5 per cent. of 306 cases having no râles, also had parenchymatous lesions as seen on the x-ray plates. Moderately coarse râles were found in 425, (78 per cent.) and fine râles in 120 (22 per cent.) of the 545 cases with râles at an apex, or apex and elsewhere in the lung.

Table 4 shows the frequency of occurrence of pleurisy with effusion, hemoptysis, moderately coarse and fine râles variously located and tubercle bacilli in the sputum, when the x-ray findings are negative,

peribronchial and parenchymatous in type. From this table it may be seen that in this analysis, peribronchial lesions are associated with pleurisy with effusion almost twice as frequently as parenchymatous lesions (7 per cent. and 4 per cent. respectively). Parenchymatous lesions show greater association with hemoptysis than peribronchial (30 per cent.—8 per cent.). But negative x-ray cases have almost as great association with hemoptysis as the parenchymatous lesion.

Moderately coarse râles were found in the upper third or more of the lung in 57 per cent. of 735 parenchymatous and 3 per cent. of 237 peribronchial cases.

TABLE 3

Occurence and Location of type of rales in Negative, Perbronchial & Parenchymatous X-ray groups (1,000 cases)

Rales	No. of Cases	28 Neg. X-ray		237 Peribronch		735 Parenchy	
		No.	%	No	%	No	%
Questionably Present	36	1	2.8	16	44.4	19	52.8
Present	658	7	1	62	9.4	589	89.5
Mod. Coarse upper ⅓ or more	425	0		7	2	418	98
Fine upper ⅓ or more	120	6	5	18	15	96	80
Fine upper ⅓ M.C. at base.	20	0		7	35	13	65
Fine or M.C. Middle Only	26	0		3	11.5	23	88.5
Fine or M.C. Basal Only	67	1	1.5	27	40.3	39	58.2
No. Rales	306	20	6.5	159	52	127	41.5

Fine râles in the upper third or more were found in 13 per cent. of 735 parenchymatous, 8 per cent. of 237 peribronchial and 21 per cent. of 6 negative x-ray cases.

Fine or moderately râles in the central portion of the lung only were found in 3 per cent. of the parenchymatous and 1 per cent. of the peribronchial cases.

Fine râles in the upper third of the lung and moderately coarse râles at the base occurred in 2 per cent. of the parenchymatous and 3 per cent. of the peribronchial cases.

Basal râles only occurred in 5 per cent. of the parenchymatous, 11 per cent. of the peribronchial and 4 per cent. of the negative cases.

Râles were indefinite or were not present in 20 per cent. of the parenchymatous, 74 per cent. of the peribronchial and 75 per cent. of the negative cases.

Tubercle bacilli were found at the sanatorium in 61 per cent. of the

TABLE 4

X-ray types associated with Wet Pleurisy, Hemoptysis, Rales, Bacilli.

X-Ray		Wet Pleurisy		Hemoptysis		RALES												Bacilli Residence	
						Mod. Coarse upper ⅓ or more		Fine upper ⅓ or more		Fine upper ½ M.C. Base		Fine or M.C. Middle		Fine or M.C. Base		Questionably or not present			
	No.	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Neg.	28	0		6	21	0		6	21	0		0		1	4	21	75	0	
Pb. Peribronchial	237	17	7	20	8	7	3	18	8	7	3	3	1	27	11	175	74	12	5
Pc. Parenchymatous	735	30	4	220	30	418	57	96	13	13	2	23	3	39	5	146	20	447	61

parenchymatous and 5 per cent. of the peribronchial cases. No negative x-ray case had positive sputum at the sanatorium.

Considering these various analyses, on the whole it can be reasonably said that:

1. Inasmuch as 90 per cent. of the cases having hemoptysis showed a definite parenchymatous x-ray lesion, this symptom is of great significance in diagnosis.
2. Pleurisy with effusion as a diagnostic symptom of pulmonary tuberculosis (not pleural tuberculosis) falls considerably below hemoptysis in value since only 64 per cent. had definite evidence of intrapulmonary involvement as seen by the x-ray. (Due to inability to see through the fluid?)
3. The finding of persistent râles, especially moderately coarse râles in the upper third of the lung, is of great significance in the diagnosis of pulmonary tuberculosis, inasmuch as the lesion can be shown to be intrapulmonary by the x-ray in 90 per cent. of the cases.
4. The demonstration of tubercle bacilli in the sputum is almost always associated with a demonstrable intrapulmonary lesion (97.4 per cent.).
5. The moderately coarse râle is almost always (98 per cent.) associated with demonstrable intrapulmonary lesions as seen in the x-ray plate. The fine râle being of somewhat less importance (80 per cent.) in diagnosis.

6. When râles are found only at the base, their diagnostic significance for pulmonary tuberculosis is questionable.
7. Râles lose in diagnostic significance for pulmonary tuberculosis as they occur in isolated areas from the upper third of the lung downward (apex-middle-base).

THE INTRA-CUTANEOUS REACTION IN THE TUBERCULOUS TO GLYCERINE BOUILLON AND TUBERCULIN*

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Intra-cutaneous tests were given with tuberculin and glycerine bouillon to determine to what extent, if any, the inflammatory reaction to tuberculin in the skin was due to the glycerine bouillon content of the tuberculin. The glycerine bouillon was prepared as usual for the preparation of tuberculin O.T. and evaporated in the same way as though O.T. were being made. Dilutions of glycerine bouillon, which is hereafter called "G.B." and tuberculin were made decimally and 1/10 cc. was the volume of solution always employed. The tests were given at the same time in the same forearm, the tuberculin being proximal or as in some instances, lateral to the G.B. Measurements were made at the end of 24 and 48 hours.

The initial dose was 0.000,000,1 cc. G.B. and 0.000,000,1 cc. tuberculin, and if no inflammatory zone of at least 18 mm. diameter resulted, ten times the dose (0.000,001 cc.) was given on the next injection three or four days later. When no reaction resulted the dose was increased ten times at each subsequent injection until an inflammatory reaction of at least 18 mm. resulted. The volume of the dose remained 1/10 cc.

In all 443 cases were tested. Of these 377 or 85 per cent. reacted to tuberculin only, 17 or about 4 per cent. reacted to tuberculin and G.B. and 4 or 0.9 per cent. reacted to G.B. only. In the last instances it is quite certain that a mistake was made in copying the reaction under the wrong heading on the cards used for the purpose.

In 45 cases the tuberculin produced a reaction of 18 mm. and the G.B. one of 10 mm. at the same time. So that on the basis of an 18 mm. reaction (inflammation) it may be said that 422 of 443 tuberculous individuals (95 per cent.) reacted to tuberculin only.

The majority of the cases reacted to a dose of 0.000,1 cc. O.T. It may be said, therefore, that in the doses used, the G.B. had but little tendency to cause reactions (inflammation) in the skin of the tuberculous.

In order to see if the above conditions held true for guinea pigs, a series of skin tests with tuberculin and G.B. was given to guinea pigs.

* Read by title.

In all twelve pigs were used in experiment. The intradermic skin tests were given with 1/10 cc. of a 5 per cent. solution of tuberculin O.T. and 1/10 cc. of a 10 per cent. solution of G.B. the first day. These tests were all negative after 24 and 48 hours. Four days later these same pigs received 0.25 cc. of a 10 per cent. solution of G.B. and two days later 0.5 cc. of a 10 per cent. solution of G.B. and two days later (8th day) 0.1 cc. of full strength G.B. All the above skin tests were negative with the exception of two (0.1 cc.) which were questionably positive.

On the 11th day 0.1 cc. of a thin emulsion of human tubercle bacilli was injected intraperitoneally. On the 21st day 0.25 cc. of a 10 per cent. solution of G.B. and 0.1 cc. 5 per cent. O.T. were injected into the skin. Two of the pigs showed reactions to the tuberculin. None reacted to G.B. On the 29th day 0.50 cc. of a 10 per cent. solution of G.B. and 0.1 cc. 5 per cent. O.T. were given into the skin and 7 pigs reacted to the tuberculin. None reacted to G.B.

On the 37th day 0.1 cc. full strength G.B. and 0.1 cc. 5 per cent. O.T. were injected into the skin. All twelve pigs showed reaction to the tuberculin and two to the G.B. as well. These two were the same pigs that questionably reacted to 0.1 cc. full strength G.B. on the 8th day.

On the 39th day seven pigs died. Four lived for several weeks and one for several months. At autopsy all showed extensive tuberculous hepatitis, spleenitis, mediastinal and mesenteric adenitis, omental and slight pulmonary tuberculosis.

It is realized that only a very small number of animals were used and that the results cannot be looked upon as conclusive. However, they are suggestive. In the adults the number of tests is very much larger and consequently of more significance.

CONCLUSIONS

Glycerine Bouillon prepared as described is not of itself likely to produce inflammatory reactions of 18 mm. diameter in the skin of healthy guinea pigs when given up to 0.1 cc. of a 100 per cent. solution.

Two of twelve tuberculous pigs gave a positive reaction to 0.1 cc. of a 5 per cent. tuberculin (O.T.). This shows that G.B. at times does give a positive skin reaction when given at the same time as tuberculin in some tuberculous guinea pigs. In the adults approximately 5 per cent. of 443 cases reacted to G.B. About one-fifth of these can be attributed to error. This leaves 4 per cent. which reacted to G.B. and tuberculin, weakening to this extent the value of the tuberculin skin test as a specific test. On the other hand a hypersensitive patient may react to G.B. during a reaction produced by tuberculin.

Finally we wish to express our thanks to Dr. Kakaturo T. Sasano who performed the guinea pig tests for us.

A DISCUSSION OF CLASSIFICATIONS IN TUBERCULOSIS: THE ANATOMIC VERSUS THE PHYSIOLOGIC CONCEPTION*

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The development of medicine during the past half century has been along lines which have accentuated the anatomic idea. Anatomy, histology, macroscopic and microscopic pathology have dominated the field. Normal and pathologic cells and normal and pathologic groups of cells as we find them in organs have been the object of investigation. Form and structure have been given a place of greater importance than function.

This character of study has completely dominated medical discussions. In medical societies papers and discussions have been classified and rated very much according to their treatment of the pathologic changes in the tissues involved. A feeling of satisfaction has always followed the presentation of a specimen or a microscopic slide showing anatomic change. The changes in function, however, which are represented by the symptoms and constitute the pathologic physiology of the case are often, in fact, usually, hurriedly and inadequately described; and rarely is any attempt made to explain the manner of their causation. Regardless of the fact that diagnosis depends largely upon the recognition of disturbance of function and the fact that it is disturbance of function which usually causes the patient to consult the physician and the further fact that the restoration of function is the chief purpose of therapy, this phase of medicine has been but illy considered.

This anatomic conception has led to the magnification of the organ as a structure rather than as a functioning group of cells, influencing and being influenced by other organs through the nerves and internal secretions. Size, position and pathologic change in cells and organs has meant more than function. It has further led to the grouping of specialties according to the organ involved. These conceptions of disease are extremely narrow. Tonsillitis is only accidently a disease of the tonsil. In reality it is an infection produced by a microorganism which in this particular instance happens to be in the tonsil; but because of its location its treatment is assumed by the throat specialist. The same germ in the ear calls for an otologist; in the heart for a cardiologist; in the lung for

* Read by title.

a lung specialist: in the appendix for a surgeon; in the joint for an internist. Pneumonia and typhoid fever are not diseases confined to the lung on the one hand and the intestines on the other. Both are general infections; but we have not learned to think of them in that way. So is tuberculosis a general infection which locates now in the lung, now in the kidney, joint or some other structure. Its intelligent treatment calls for an internist who has a broad grasp of the human body.

Disease affects anatomic structure and converts it into pathologic structure. This change is not of serious import, unless it is accompanied by altered function, either local or in other parts of the organism. The various changes in function which accompany disease are recognized as symptoms; and, taken together make up the picture by which the disease is known and recognized. Anatomic change may be very extensive and yet not be serious; but, if it produces marked disturbance in function, it may become a menace to the organism no matter whether the anatomic extent be great or small.

An anatomic conception of disease affords a very poor basis for prognosis. A physiologic conception, on the other hand, affords a picture of the manner in which the organism is reacting toward the disease and gives a better basis upon which to make a prognosis. A broad view of medicine, however, can only be attained by a combination of these two conceptions.

In tuberculosis, we have been guided and bound by the anatomic conception. We have classified the disease into stages marked by arbitrary boundaries. Every classification has been, at bottom, an anatomic one.

The classification of Turban into first, second and third stages, according to the extent of the lesion has been accepted and made the basis of all adopted classifications. While it has been modified, yet it seems impossible to get away from it.

Turban's[1] original classification was as follows:

Stage I. Slight lesion not to exceed one lobe in extent.

Stage II. Slight lesion not to exceed two lobes in extent, or if a more serious lesion, not to exceed one lobe in extent.

Stage III. All lesions more extensive than those of Stage II.

In discussing this classification before the First International Conference on Tuberculosis, in Berlin in 1902, Turban[2] said: "I have shown that the prognosis of pulmonary tuberculosis is not dependent so much upon any other factor as *its degree of spreading* in the lungs." And in explanation of the terms used he said:

"As a *slight* lesion is to be understood disseminated nodules which are recognized on physical examination by slight impairment of the percussion note, rough, weakened vesicular, vesiculobronchial or bronchovesicular breathing, and fine and medium râles; as a *severe lesion* is to be understood dense infiltration and cavity which are to be recognised by dullness or tympanitic percussion note, weak bronchovesicular, bronchial or amphoric breath sounds, and medium or large or metallic râles. Slight pleuritic dullness is to be left out of account, but when it is

extensive it is to be considered as a complication. The 'volume of one lobe' is the same as 'two half lobes.' Slight changes in breath sound without percussion changes and râles are not to be considered."

At the Sixth International Conference held in Vienna in 1907, the Turban-Gerhardt Classification as followed by the Imperial German Board of Health,[3] was adopted. This follows the same anatomic scheme as suggested by Turban but lessens the amount of involvement for the various stages and modifies and clarifies the descriptions in certain respects as follows:

Classification Turban-Gerhardt (Imperial German Board of Health):
R-right. L-left.

I. Disease of slight severity, limited to small areas of one lobe, in case of affection of both apices the disease does not extend beyond the spine of the scapula and the clavicle, in case of affection of one apex, it does not extend beyond the second rib anteriorly.

II. Disease of slight severity, more extensive than I, but affecting at most the volume of one lobe; or severe disease, extending at most to the volume of one-half lobe.

III. All cases extending beyond II, and all such with considerable cavity formation.

By disease of *slight severity* is to be understood: disseminated foci manifested by slight dullness, indistinct rough or weak vesicular, vesiculo-bronchial, or broncho-vesicular breathing and fine and medium râles.

By *severe disease:* dense infiltration recognised by marked dullness, very weak (indeterminate) broncho-vesicular, or bronchial breathing, with or without râles.

Considerable cavity formation, as recognised by tympanitic sound, amphoric breathing, and extensive, coarse consonating râles come under Stage III.

Pleuritic dullness, if only of a few centimeters extent is to be left out of account; if it is considerable, pleuritis should be especially mentioned under tuberculous complications.

The stage of disease is to be indicated for each side separately. The case, as a whole, is to be classified according to the more diseased side; for example: R II, L I—Stage II.

The National Association for the Study and Prevention of Tuberculosis followed the dominant anatomic basis of the Turban and Turban-Gerhardt classifications but added a physiologic conception by requiring the consideration of symptoms in determining the status of the patient. This is a real advance in the conception of the disease. In practice, however, it seems that the anatomic overshadows the physiologic aspects. The classification is as follows:

Incipient.—Slight or no constitutional symptoms (including particularly gastric or intestinal disturbance or rapid loss of weight). Slight or no elevation of temperature or acceleration of pulse at any time during the twenty-four hours.

Expectoration usually small in amount or absent. Tubercle bacilli may be present or absent.

Slight infiltration limited to the apex of one or both lungs or a small part of one lobe.

No tuberculous complications.

Moderately advanced.—No marked impairment of function, either local or constitutional.

Marked infiltration more extensive than under incipient, with little or no evidence of cavity formation.

No serious tuberculous complications.

Far advanced.—Marked impairment of function, local and constitutional.

Extensive localized infiltration or consolidation in one or more lobes.

Or disseminated areas of cavity formation.

Or serious tuberculous complications.

This was further amplified and the physiologic conception further emphasized by Rathbun and adopted by the American Sanatorium Association in 1916, as follows:

Lesions	Symptoms
Incipient. Slight infiltration in the apex of one or both lungs, or a small part of one lobe. No tuberculous complications.	A. (Slight or None). Slight or no constitutional symptoms, including particularly gastric or intestinal disturbance, or rapid loss of weight; slight or no elevation of temperature or acceleration of pulse at any time during the twenty-four hours. Expectoration usually small in amount or absent. Tubercle bacilli may be present or absent.
Moderately Advanced. Marked infiltration, more extensive than under incipient, with little or no evidence of cavity formation. No serious tuberculous complications.	B. (Moderate). No marked impairment of function, either local or constitutional.
Far advanced. Extensive localized infiltration or consolidation in one or more lobes. Or disseminated areas of cavity formation. Or serious tuberculous complications.	C. (Severe). Marked impairment of function, local and constitutional.

Acute Generalized Miliary Tuberculosis

This scheme offers the following combinations:

Incipient A.	Moderately Advanced A.	Far Advanced A.
Incipient B.	Moderately Advanced B.	Far Advanced B.
Incipient C	Moderately Advanced C.	Far Advanced C.

In addition to the classification already adopted, Brown, Heise, and Sampson[4] suggested the following x-ray findings:

Minimal: X-ray findings to show a total area involved (parenchymatous) not greater than the area to the upper level of the 2d chondrosternal junction on one side (both sides may be involved) in the form of scattered mottling, or an intense shadow interpreted as pleuritic.

Moderately advanced: The x-ray to show an intense shadow, not interpreted as pleuritic, of no greater extent than the area above the upper level of the 4th chondro-sternal junction on one side; or areas of rarefaction interpreted as cavities limited to one interspace; or scattered mottling over a greater area than under "minimal" but not greater than the area of one entire lung and to the level of the 2d chondrosternal junction on the opposite side.

Far Advanced: The x-ray to show an intense shadow, not interpreted as pleuritic, of greater extent than the area above the upper level of the fourth chondro-sternal junction of one side, or areas of rarefaction interpreted as cavities, greater than one interspace, or scattered mottling greater in extent than under "moderately advanced."

The following will be the conditions on discharge:

Apparently arrested: All constitutional symptoms and expectoration with bacilli absent for a period of three months; the physical signs and x-ray findings to be those of a healed lesion.

Quiescent: Absence of all constitutional symptoms; expectoration and bacilli may or may not be present; physical signs and x-ray findings to be stationary or retrogressive; the foregoing conditions to have existed for at least two months. It must be borne in mind that increase of physical signs with lessening of symptoms and improvement of general condition may occur in quiescent cases. However in these cases the x-ray must be stationary or retrogressive. The length of time mentioned is, of course, somewhat arbitrary, but is intended to cover the cases which frequently occur where the patients leave a sanatorium for various reasons, contrary to advice, after a stay of a few weeks, although all active symptoms may have ceased completely soon after entrance.

Improved: Constitutional symptoms lessened or entirely absent, physical signs and x-ray findings improved or unchanged; cough and expectoration with bacilli usually present.

Unimproved and Progressive: All essential symptoms, physical signs and x-ray findings unabated or increased.

Died.

ULTIMATE RESULTS

Apparently Cured: All constitutional symptoms and expectoration with bacilli absent for a period of two years under ordinary conditions of life.

Well: Patients who fulfill all the conditions required under "apparently cured" but about whose sputum no definite information can be obtained.

Arrested: See "Quiescent" above.

Improved: See above.

Progressive: See above.

Dead.

Precedent to a discussion of classifications it is well to consider the purposes which they are intended to serve. Prior to the beginning of the present century tuberculosis had received but scant attention at the hands of medical men. Then the disease began to lose its hopelessness and a great interest was created throughout the medical world in its prevention and cure. Turban offered his classification at that time as a means "of arriving at uniformity" in reporting patients and the result of their treatment, believing that "its degree of spreading" was the most important factor in prognosis.

Uniformity presupposes that all examiners have equal or nearly equal ability to examine and that all examine with equal care; and further, that all interpret with equal judgment; but such is not the case. Classifications have served good purposes, but they have done this in spite of the fact that they have not produced uniformity. Classification of the disease in stages has done much to show that the less extensive cases of tuberculosis without marked physiologic disturbance, are the more favorable ones for treatment. It has further demonstrated to more careful observers that anatomic extent without taking into consideration physiologic severity is of comparative little value in prognosis except when gross destruction of tissue has occurred, and has also caused examiners to study their cases with greater earnestness and examine with greater care, a very important thing during the period when the study of clinical tuberculosis was in the stage of rapid development.

The greatest error fostered by following classifications is that of impressing upon the minds of men that the extent of the lesion is the greatest factor, and that the seriousness of the case can be mechanically measured. It has caused workers to concentrate their attention upon the disease instead of the patient. While the classifications which are followed in this country are a combination of extent and character of the lesion on the anatomic side and of the manner in which the patient is reacting on the physiologic side, yet in reality the anatomic side is uppermost in the minds of nearly all observers. Aside from emphasizing the anatomic side unduly, where the physiologic side is considered, the symptoms are treated too much as though they were distinct and separate phenomena always caused by the same condition. It is an attempt to assign mechanical exactness to processes which by nature are most inexact.

All classifications emphasize and aim at the myth of medicine, "uniformity;" when, in actual practice, uniformity can not exist.

As long as the balance between the developing powers of bacilli and the resistant qualities of different patients differ; and as long as the nervous, chemical and psychical equilibrium of patients differ, so long will uniformity in disease of the human being be unattained and unattainable. Race, age, economic status, constitution, growth, nerve and chemical balance, and psychical equilibrium are some of the factors that must be considered in every case. Likewise the ability of the examiner and the methods used permit of very great variation.

In no way can the methods used be illustrated better than in the examination of sputum for bacilli, a procedure which many think fairly exact. On the contrary the determination of the presence or absence of bacilli in the sputum as carried out in laboratory practice is a very inexact procedure, and even as suggested in the classification adopted by the National Association is subject to great error. The requirements as suggested are as follows:

"A careful microscopic examination, with a mechanical stage, of two smears, devoting at least three minutes to each smear, made from selected particles (at least six from different parts) of the sputum on each of three successive days. The morning sputum should always be obtained, or better the minute bits that some arrested patients raise at very infrequent intervals. It is not yet deemed wise to insist on digestion and centrifugalization or on inoculation of guinea pigs."

In a comparison of direct smear with a method of enrichment, which we use in our laboratory, it was shown that in 409 comparisons, the number of bacilli found in a given time of search was 14.7 times greater by the latter than by the former method. In order to find bacilli with direct smear methods, Dr. J. E. Pottenger has computed that there must be about two thousand bacilli per cubic millimeter of substance examined while with the enrichment method they may be found, if present, in numbers of about two hundred per cubic millimeter.

The length of time spent in searching the specimen in case of rare bacilli is also of tremendous importance, as will be seen from the following analysis based on one, three, five, ten and fifteen minutes' search in the 409 specimens above mentioned.

Diagnosis made in	1 minute's search	29 per cent.
Diagnosis made in	3 minutes' search	59 per cent.
Diagnosis made in	5 minutes' search	72 per cent.
Diagnosis made in	10 minutes' search	92 per cent.
Diagnosis made in	15 minutes' search	100 per cent.

Search was carried out in some instances for two hours, but it was found that only rarely was a diagnosis made after the fifteenth minute. Therefore, we have established this enrichment method with fifteen minutes' search as the standard in our work.

It is desirable to know as nearly as possible what are the chances for a given patient to improve, or to bring his disease to a state of quiescence or arrestment; but such an opinion cannot be given except after studying the individual from many different angles over an indefinite period of time. The disease is a chronic one and shows different phases at different times. It cannot be judged by the extent of the lesion alone, nor by its character, nor by the symptomatology at the time of examination, nor by the symptoms which are observed over any brief period. An opinion or prognosis must be based on the examiner's opinion after all available data have been considered, and after the patient has been observed long enough to show the particular type that the disease presents and the

character of the patient's resistance. It seems to me that we should treat the disease, tuberculosis, in the same manner that we treat other diseases, and that our classification should be a judgment based on all available data. The most important thing for the physician to know from the anatomical basis, is, not the extent, but whether the case is fibroid or necrotic in type, or predominantly fibroid or predominantly necrotic in type; and whether the process is progressive or stationary; and, from the physiologic standpoint, how the disease is affecting the physiologic processes of the body of the patient. From this we may determine that a given patient presents a favorable, doubtful, or unfavorable aspect, the same as we do in other diseases. The nature of this opinion, however, must necessarily differ with the examiner's experience and ability the same as in dealing with other diseases.

Such a classification would be based on the same principles which govern prognosis in every other disease—a full consideration of the disease and the patient. It may be no more uniform than that of stages, but should not be less so; and should possess the advantage that the examiner would not be obliged to fit all of his data into arbitrary standards. Like the present classification, it would depend on the examiner's opinion, but it would be freed from time-consuming attempts at standardization, which are of doubtful utility.

The scheme of classification suggested by Brown, Heise and Sampson,[4] given above, also the one presented by Waters and Amberson[5] in which findings of the x-ray are to be added to those of the older classifications are a magnification of the anatomic conception. Brown and his co-workers state that, "many have come to believe that, accepting a diagnosis of pulmonary tuberculosis, the symptoms reveal what is happening at the time of examination and consequently of classification but to the majority of workers in pulmonary tuberculosis it has appeared that a classification based on the *extent* of the pulmonary disease is to be preferred to all others." In an analysis of 814 of their own cases they state that the disease was more extensive in 48 per cent. than had shown on physical examination, therefore they believe that the x-ray should be used in determing the classification of cases. Waters likewise believes that the stereogram is necessary to determine the extent and character of the lesion in from twenty to thirty per cent.

I would like to ask the question, is the knowledge gained by this attempt at mathematical measurement adding sufficient practical benefit to the every day clinical handling of tuberculosis to make it worth while to increase the already lengthy description used in classifications, or is it rather a special piece of work establishing the fact that physical findings and x-ray examination differ somewhat in the extent of a given lesion, the latter usually showing more? Every piece of machinery makes errors, and the more utilized, the greater the danger of inexactness. If the x-ray findings can be properly made and interpreted it will add to the anatomic exactness, but it still falls short of furnishing a basis for prognosis.

The reason given for offering these new classifications is the same in both instances, viz., that the full *extent* of the lesion is not being discovered by present methods. Let us first find out whether knowing that there is half a lobe or two-thirds of a lobe involved is necessary to an understanding of the disease. Can any one measure the volume of lung involved either by physical or x-ray examination with sufficient accuracy to make this procedure a necessity in order to give a prognosis? And, after all, the ultimate reason for classification is that we may the better be able to prognosticate what the result will be in a given patient.

The divisions marking Stage I, II and III or minimal, moderately advanced, and advanced are purely arbitrary. They in no way tell us definitely what is occurring. It is far better to have a whole lobe involved with a non-virulent fibroid type of the disease than to have an area of necrosis as large as a marble or "a cavity limited in diameter to the width of the first rib at the level of the clavicle" because this type of lesion shows that the fighting balance is on the side of the patient. Further a patient who withstands an extensive active lesion will have far better chances of getting well than one who withstands a small lesion poorly. The real thing that we want to know is not so much how much lung is involved, but how is the patient reacting to the disease that he has and is he able to overcome it? What are his fighting qualities when a lesion of a given extent is present? Is the normal smooth working of his body cells interfered with and to what extent? Is he or is he not showing resistance? Is he destroying bacilli and inhibiting the multiplication of others and preventing the spread of the disease,—in other words, what is the physiologic as well as anatomic response of the individual toward his tuberculosis? So, while we cannot and should not divorce our thoughts from the extent of the anatomic involvement, and the character of the pathologic changes which have taken place, yet our chief concern should be the amount of deviation from the normal physiologic working of the body cells which has taken place.

The relatively greater importance of this physiologic as compared with the usual anatomic conception is illustrated daily in our clinical experience. While, all else being equal, the greater the extent of the disease, the greater its seriousness, yet the extent of the lesion alone is but a minor point in destroying the patient, and furthermore, at best, it cannot be even approximately measured. The intensity, or the manner in which it destroys the normal working equilibrium of the body cells is the chief factor—the physiologic departures from the normal rather than the anatomic. This is more easily measured because it is expressed in symptoms. The ability of the physiologic forces of the body to repair the anatomic destruction is another important factor.

One patient will suffer from a progressive necrosis which eventually destroys a large part of one or both lungs and still be able to regain a fair degree of health, because his physiologic balance is well preserved in spite of the extent and severity of the disease. On the other hand we

sometimes see a small lesion which profoundly affects the physiologic equilibrium of the patient and so depresses his reacting powers that the disease spreads and becomes a menacing disease.

We also now and then see what seems to be a slight lesion anatomically considered, accompanied by very few recognized symptoms and yet healing is accomplished only with great difficulty. Such cases, in my estimation, are naturally of slight virulence but fail to heal with usual rapidity because of a lack of physiologic balance on the part of the patient.

In considering the relative value of symptoms, one must take their duration or permanency into consideration, and the manner in which they affect the recuperative powers of the patient, as well as the factor which causes them.

A temperature of 102 or higher is of very different significance if it is persistent, or repeated at frequent intervals than if it is only of a few days' duration. It is also of different significance when present if the patient is exercising from what it is if he is resting. If it is increased in severity and maintained by worry it is of less significance than the same degree when the patient is happy and optimistic, because by eliminating the harmful mental state the patient improves.

The *pulse rate* differs according to the nervous and psychical state of the patient, and according to the condition under which he is living, as well as the activity of the disease. So an increase in rate alone means nothing.

Loss of weight may be caused by a lessened intake in food, due to disturbance in appetite, or a reduced power of digestion, or an increase in metabolic rate. In early clinical tuberculosis the loss which occurs is usually influenced much less by the disease than by the conditions surrounding the patient. So loss of weight is only serious when due to conditions which can not be corrected.

The *cough, expectoration* and *number of bacilli* are also variable, and misleading if considered only at some particular period of the disease. If considered only in relation to numbers, when a necrotic area is sloughing out the increase in numbers would be interpreted as indicating a very serious condition; but, a few weeks later, the activity in the process may have quieted down and the patient may be cough, expectoration and bacillus free; or, at least, all of these symptoms may be very much decreased.

Much the same may be said of all the symptoms which belong to tuberculosis.

Before we can classify our patient and make a prognosis with anything approaching accuracy, we must understand what it is that kills the tuberculous patient. At present we are not permitted to know this fully. We assume, however, that it is not primarily the disease itself. It is not primarily the inability of the lungs to furnish oxygen, nor the inability of the heart to sustain the circulation. The patent succumbs to his disease, apparently, because his physiologic processes are so disturbed that

the body cannot be kept in a state compatible with life. This implies a lessened ability to resist the onward march of the bacilli.

If we were to analyze all of the symptoms which accompany tuberculosis, we would see that the toxic symptoms are the ones which affect the physiologic working of the patient most. The effect of cough, however, must not be minimized, for when it is severe it increases the demands upon the patient's energy enormously. This has been estimated at from five to ten per cent. In severe cases, it must be much more than this. Reflex disturbances in the gastro-intestinal canal at times also

ETIOLOGICAL CLASSIFICATION OF COMMON SYMPTOMS OF PULMONARY TUBERCULOSIS

Group I.

Symptoms Due To Toxemia

Caused by Harmful Stimulation of	*Symptoms*
I. Nervous System in General II. Endocrin System in General	1. Malaise 2. Lack of Endurance 3. Loss of Strength
	4. Nerve Instability
III. Sympathetic Nervous System IV. Sympathicotropic Endocrins. Particularly Adrenals and Thyroid.	5. Diminished Digestive Activity 6. Increased Metabolic Rate 7. Loss of Weight 8. Increased Pulse Rate 9. Night Sweats 10. Temperature (partly)

Group II.

Symptoms Due To Reflex Cause

Hoarseness
Tickling in Larynx
Cough
Digestive Disturbances
(Hypermotility and Hypersecretion)
Loss of Weight
Circulatory Disturbances
Chest and Shoulder Pains
Spasm of Muscles of Shoulder Girdle and Diaphragm
Flushing of Face

Group III.

Symptoms and Syndromes Due To The Process *per se*

Spitting of Blood
Sputum
Frequent and Protracted Colds (Tuberculous Bronchitis)
Pleurisy (Tuberculosis of the Pleura)

become serious, and threaten the patient through failure of nutrition. The effect of these reflex symptoms when they become severe must not be under-rated, for often the difference between an arrestment and a failure at arrestment narrows to a very small margin. But the overshadowing importance of the toxic symptoms must be evident to all observers. This may be readily seen from the following grouping of some of the more common symptoms which are present during the disease.

With this grouping one readily discerns that, while these symptoms which are classed in Groups II and III as being of reflex origin and due to the tuberculous process *per se* may cause annoyance, they are not the symptoms which generally effect the serious changes in the organism. It is to the toxic group that we regularly assign the real danger to life. As a result of the action of toxins we have a more or less general harmful stimulation of the nerve cells which results in a general nerve instability. We further have a disturbance in the endocrin system resulting in a disturbance in the normal chemical control of the body. There results an increased acid condition of the tissues,[6] with a diminution of the free water of the body.[7] [8] This interferes with the normal chemical activity, which should take place and without which the body cannot be kept in a state of health. Whether this is a result of action through the nerves or internal secretion, or a direct action upon the body colloids is not plain. These are some of the evident causes of a failure of resistance which permits the disease to spread. There are further factors which we are only able to suggest but which we cannot define, such as the normal underlying, endocrin, nervous and psychic equilibriums, which influence the manner in which one reacts to given definite disease processes.

The real prognosis in tuberculosis, then, is in this sense individual. It does not depend alone upon the extent of the disease, nor even upon the intensity of the disease, but upon the manner in which the individual is able to preserve his physiologic equilibrium in spite of its existence and severity.

Two patients may be suffering from a tuberculosis of similar extent and as far as we are able to judge of similar intensity. Both may have a similar degree of pyrexia. One may sleep well, preserve his appetite, put on weight and feel well, while the other suffers from loss of appetite, poor digestion, loss of weight, and feels badly. What is the difference? It is not so much in the disease, as in the manner in which the two patients react toward the disease. It is not the anatomic extent of the disease or the anatomic character of the disease process that makes the difference but the difference is in the physiologic equilibrium of the two patients; and it must be remembered that the physiologic equilibrium depends not alone upon physical stimuli but psychic as well.

Without the action of the toxins in tuberculosis, there would still be many annoying symptoms, but I doubt there being many serious ones. So, in studying a given case of tuberculosis in order to determine the prognosis I would suggest that the symptoms which are of greatest im-

port are those belonging to the toxic group. In one case one symptom may be most prominent; in another, varying with the physiologic balance which is normal to the individual as well as the one maintained during the illness; but any case which shows for any great length of time an unfavorable reaction to the toxins, must be classed as relatively unfavorable.

The symptoms in the end are the key to prognosis, and must be considered at least equally with the extent of the lesion. It may be too bold to suggest that the classification of tuberculosis into stages be abolished; yet I am convinced that we have progressed sufficiently far now to divorce ourselves from the domination of the anatomic conception. The anatomic conception has a tendency to force a mechanical attitude toward the disease and to do away with the personal element, which is the greatest factor in disease. The physiologic conception, on the other hand, is based on the personal element, hence encourages the study of each patient as a reacting organism. An intelligent understanding of tuberculosis, however, can be obtained only by combining the two. If we are to continue classifications, let them be based more generally upon a physiologic conception of the disease, in which its chronic nature is fully recognized.

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THE EFFECT OF HYDROGEN ION CONCENTRATION ON THE PRODUCTION OF CARBON DIOXIDE BY BACILLUS TUBERCULOSIS*

By Matilda Moldenhauer Brooks

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(Abstract)

In studying the effects of certain derivatives of chaulmoogra oil on *Bacillus tuberculosis*, it became necessary to determine the effects of changes in the H ion concentration before drawing any conclusions from the results. For comparison another acid-fast organism, *Bacillus butyricus*, and a non acid-fast organism, *Bacillus subtilis*, were used.

The writer has used the production of CO_2 as a measure of metabolic activity of the organism. The method shortens the time necessary in most of the other methods generally in use, and affords results which are both immediate and accurate.

The method used is that described in a previous publication[1] except that the apparatus is made entirely of Pyrex glass. It consists of a closed system through which the air is forced to circulate. There are two Pyrex glass tubes at either end, one containing the bacteria under observation, and the other containing the indicator which measures the amount of CO_2 present under various conditions.

The reciprocal of the time required for the change in pH value (in the indicator tube) from 7.8 to 7.6 is taken as the rate of production of CO_2. This time varied according to the amount of bacterial suspension used.

The organism, H 37 was obtained from the stock cultures of the Hygienic Laboratory, was grown in glycerine broth from 4 to 6 weeks before use, washed in a solution of 1 per cent. dextrose in distilled water, centrifugated, resuspended in dextrose solution.

Solutions of H_2SO_4 and NaOH were used to change the H ion concentration of the bacteria.

The amount of alkali added in the experiments on *Bacillus butyricus* and *Bacillus subtilis* in every case was too small to affect the observed rate of CO_2 production by the formation of carbonates. But in the experiments with *Bacillus tuberculosis* larger amounts of alkali had to be used and in this case a temporary buffer effect is very apparent.

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This paper has been published in full in the American Review of Tuberculosis.

For this reason the data represented are those obtained only after the rate had become constant.

It was found that the acid tolerance of *Bacillus tuberculosis* is far in excess of that of the other two organisms. The rate of normal CO_2 production extends from pH 7.4 to pH 4.4. From this point the rate gradually diminishes to about 20 per cent. of the normal at pH 1.0. In the case of *Bacillus butyricus* which is not so acid-fast as *Bacillus tuberculosis,* the rate decreases on the acid and the alkali side of pH 7.0, while the rate of *Bacillus subtilis* decreases on the acid and the alkali side of pH 6.8. The decrease below pH 6.8 is more rapid in the case of *Bacillus subtilis* than in that of *Bacillus butyricus.* In the region of alkalinity there is a similarity in the behavior of all of these organisms, as shown by the effect of an alkaline medium, decreasing the rate to zero at a pH of about 8.5.

Summarizing briefly the results, it was found that *Bacillus tuberculosis* has a marked tolerance (when measured by the rate of production of CO_2) for acid when placed in dextrose solution having a pH from 4.4 to 7.4. On either side of these figures there is a decrease in the rate of CO_2 production.

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NOTES ON THE ACTION OF COD-LIVER OIL ON THE TUBERCLE BACILLUS*

By Hugh Baird Campbell, M.D., and Jean Kieffer

Norwich, Conn.

Probably no other drug has been so closely associated with the treatment of tuberculosis in the past one hundred years as has oleum morrhuae —cod-liver oil. Introduced first into the materia medica of England in 1771, by Percival, for the treatment of rheumatism, rickets, and sciatica, it was adopted by the French Codex just one hundred years ago, in 1822. After the publication of Bennett's treatise on Oleum Jecoris Aselli (1841), no practice of medicine was complete unless it held forth at length on the efficacy of this oil in the treatment of phthisis.

The nutritional value of cod-liver oil has until lately been held to be the cause of its therapeutic action, but from a review of the research work done in different fields of medicine in the last few years, one wonders if this property of the oil to be an easily assimilable food is its only, or even its main, value as a therapeutic agent.

The work done by Heiser,[1] and followed by a number of workers in the treatment of leprosy with chaulmoogra oil, then the work of Leonard Rogers [2] and his associates with derivatives of chaulmoogra oil, has suggested the possibility of similar properties of cod-liver oil and derivatives in the treatment of tuberculosis. This has already been tried out by L. Rogers [3] and G. Ganguili [4] who reported successful use of a sodium salt of the unsaturated fatty acids of cod-liver oil, sodium morrhuate, in the treatment of tuberculosis. In his paper Rogers quotes Captain Knowles as saying: "It is the best line of treatment for tuberculosis in general." However, the results of Biesenthal,[5] in 1920, with the same preparation were unsatisfactory and led the latter to disagree with this view, although he concludes his paper with the words: "Further work with sodium morrhuate should be undertaken to prove or disprove the views of Rogers."

In another field, the work of Calmette [6] in attenuating tubercle bacillus in bile media, raises the question as to whether or not the liver extract of the cod has any germicidal, attenuating or inhibiting power on the tubercle bacillus. Then the direct bacteriological work of Walker and Sweeney [7] and Kolmer, Davis and Jager [8] with chaulmoogric acid and chaulmoogra oil suggests similar experiments to be done with cod-liver oil.

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At the suggestion of Dr. Stephen J. Maher, we started early in 1921 a series of experiments to study the action of cod-liver oil and derivatives and cod-liver extracts on the tubercle bacillus.

It is quite evident that a bacteriological study of cod-liver oil pursued only with the ordinary medicinal oil used in America would at best be very incomplete and probably misleading as to results, consequently cod-liver oil obtained in the raw state with as little refinement as possible is necessary. As Dean and Wrenshall [9] point out, little head-way was made in the study of chaulmoogra oil until a uniform reliable product was obtained.

The commercial cod-liver oils now on the market differ widely in preparation, composition, and also in adulteration, and to be sure that we were using cod-liver oil we obtained fresh cod-livers from Gloucester, Mass., and extracted our own oil from these. The livers were crushed, a small amount of water added and the whole put in canvas bags, after application of mild heat (85° C) to lower the viscosity of the oil, and allowed to drain. The clear oil was decanted and used as such. (For the sake of brevity in referring to it we called this oil cold oil). One batch of cod-liver oil was also made by letting the livers simmer in water over night before draining, the fluid passing giving us a slightly brownish oil on top which we called hot oil. The water in which the livers had been cooked in the last process was then filtered, adjusted to a reaction of plus 0. 5 and 6 per cent. glycerine added. We used this glycerinated aqueous extract of cod-livers for making experimental media, as explained subsequently. Commercial refined cod-liver oil was obtained from a local wholesale druggist.

Some differences in the characteristics of these three cod-liver oils, cold, hot and refined, were noted. After manufacture, the cold oil was very clear, the hot oil had a very faint turbidity, the refined oil as bought was clear. As to color, the cold and the refined oils were of the same pale shade of yellow, the hot oil was very slightly more brownish. Their reactions as shown by litmus paper dipped in alcohol were: cold oil and hot oil, neutral; refined oil, very faintly acid.

After a few months at room temperature, the cold oil remained perfectly clear, the hot oil cleared up, the slight turbidity being replaced by a very fine sediment adhering to the side of the flask, the refined oil developed a slight turbidity with formation of a fine tenacious pellicle. In the ice box the refined oil remained perfectly fluid, the cold oil and the hot oil both solidified to a slight extent with appearance of a whitish flocculus. (The higher melting point of the oils manufactured by us would seem to indicate a relatively higher content of fatty acids of high melting point).

The aqueous extract of cod-livers, after filtration, was of a brownish color and opalescent appearance, i.e., it appeared clear and brown in color by transmitted light, but by reflected light it seemed turbid and showed greenish and reddish hues. Filtration with talcum did not rid the extract of the opalescent sheen.

Potato culture media were made from the four substances described as well as from cotton-seed oil and distilled water, the last two for control. These media were made by putting the cut potatoes in these respective fluids, autoclaving at 5 lbs. for 15 minutes and tubing in constriction tubes containing the same respective liquids up to the constriction. They were all finally autoclaved at 15lbs. for 30 minutes.

Glycerine bouillon, glycerine broth potatoes and glycerine agar slants were also used as well as slants of glycerine agar containing potato broth, which we called Bogap (*Bo*uillon, *g*lycerine, *a*gar, *p*otato) for brevity. This last medium is a modification of Petroff's potato infusion [10] and is under experimentation by us at present.

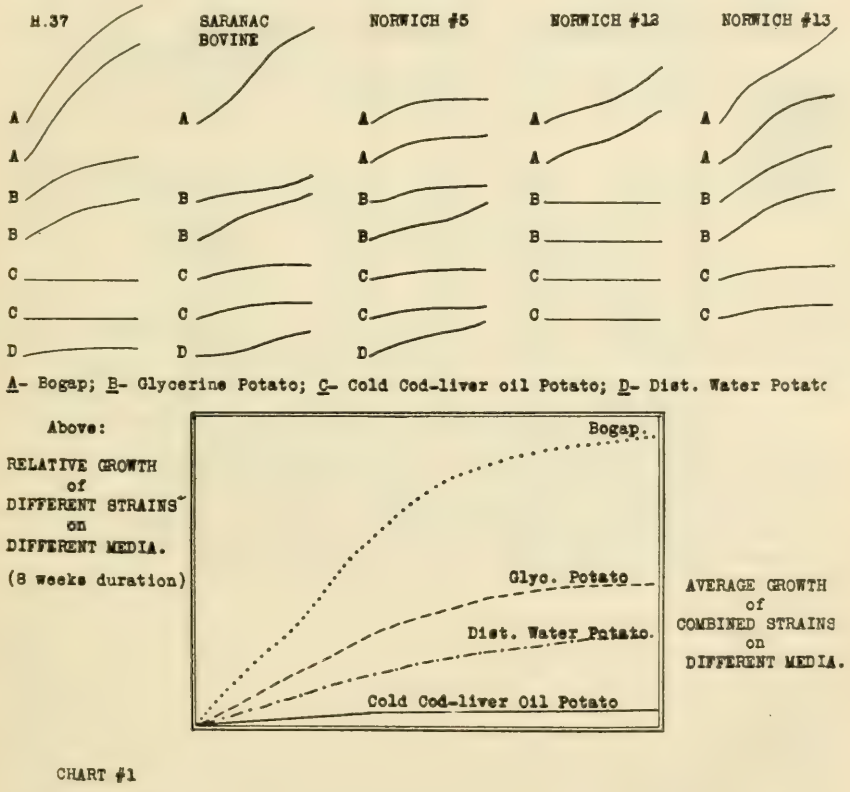

CHART #1

The different strains of T. Bc. used in the experiment were:

Human Standard — H 37 Saranac
Bovine Standard — Saranac Bovine
Untested Strains — Norwich 5
Norwich 12
Norwich 13

These last three strains were isolated from the sputa of patients at the Norwich Sanatorium. They are seemingly human strains although they have not been tested through rabbits.

These five strains were planted on Bogap, glycerine potato and cold oil potato, and H 37, Saranac Bovine and Norwich 5 on distilled water potato also.

The upper part of chart No. 1 shows the relative curves of growth of each of these tubes for eight weeks' time.

The graphic chart at the bottom shows the average curve of growth of the five strains combined, on the different media (distilled-water potato only three strains).

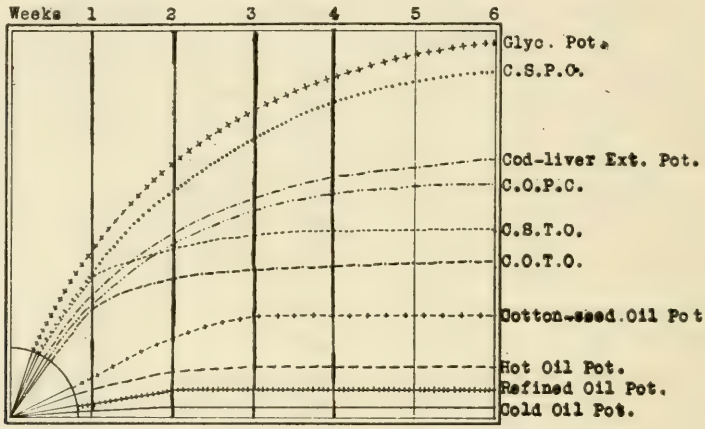

DIAGRAM SHOWING GROWTH OF H.37 ON DIFFERENT MEDIA.

C.S.P.O. and C.O.P.O. are tubes containing glycerine-potato and cotton-seed and cold-cod-liver oil respectively at the bottom. (The potatoes have never been touched by the oil.) C.S.T.O. and C.O.T.O. are tubes similar to the two above except that the oil has been flowed over the potato by turning the tubes over after the H.37 had been allowed to grow for a week.

CHART #3

It can be clearly seen that the Bogap gave by far the best growth, the glycerine potato coming next. On the distilled-water potato the strains grew fairly well. On these media, growth was progressing up to the sixth week, where the curves flatten, indicating a slowing down of the growth.

On the cold oil potato growth was very small and was arrested after the third week as the very flat line indicates. As no absolute standards could be used to record the growth of the bacteria in a graphic way, these

charts merely show the growth of the cultures as they appeared to the eyes in relation to the normal amount of growth shown by the particular bacterium on ordinary media. Moreover, it was very difficult to observe and record the growth of the organisms on the oil media. On the cod-liver oil potatoes, growth was so small that recorded growth might only have been a swelling of the transplanted material due to absorption of oil, especially since this material lost its normal dry appearance and began to look moist and oily after transplantation.

Chart No. 2 shows the behavior of H 37 on the different media (six weeks' duration).

The glycerine potato shows an evenly progressing curve of very good growth flattening toward the sixth week.

The cotton-seed potato shows a fair growth up to the third week, then a total arrest. The hot oil potato does not give as good a growth as the cotton-seed potato but it also shows an arrest of growth after three weeks.

The refined oil potato and cold oil potato gave very little growth, the refined oil potato slightly higher; growth was arrested after the second week.

On potato saturated with glycerinated watery extract of cod-livers, growth was very good (about two-thirds of glycerine potato) showing an even curve of growth flattening around the sixth week.

To get a better measure of the difference in inhibitory action between cotton-seed oil and cold cod-liver oil, H 37 was transplanted on four pieces of potatoes saturated with glycerine broth and inclosed in constriction tubes, two of them containing cotton-seed oil and two others cold cod-liver oil up to the constriction. After one week's growth one of each was turned over so as to get the oil to flow over the growth.

As the diagram shows, the growth on the potato in the tube containing cotton-seed oil, but not turned over (C. S. P. C.) have a growth parallel and almost as abundant as the ordinary glycerine potato media but a sharp break can be seen in the curve of the tube turned over after one week (C. S. T. O.) although it continued to grow to a moderate extent.

The growth on the glycerine potato with cold cod-liver oil (not turned over) (C. O. P. C.) was fair but far below the growth on plain glycerine potato, showing marked flattening of the curve after four weeks.

The tube turned over after one week (C. O. T. O.) shows a very sharp break in the curve immediately after the cold oil has come in contact with the growth and very little change thereafter.

Well worthy of note is also the fact that after three months in the incubator, the growths on the glycerine potato flooded with cotton-seed oil had progressed so that it covered most of the potato, while the growth on the glycerine potato similarly treated with cold cod-liver oil was finally arrested after contact with the oil.

These cultures on glycerine agar, glycerine potato, cod-liver extract and cotton-seed oil potato, when transplanted to glycerine agar and glycerine potato gave good growth, whereas similar transplants made from the cultures on the cod-liver oil preparations did not show any growths.

H 37 and Saranac Bovine were also planted on glycerine bouillon and glycerinated watery extract of cod-livers. H 37 grew equally well for three weeks on the bouillon and cod-liver extract when the growth on cod-liver extract went to the bottom and ceased to grow. On bouillon, the growth continued slowly but was not abundant after seven weeks. The Saranac Bovine grew abundantly and equally well on both media for three weeks when parts of the film on cod-liver extract fell to the bottom and then the growth remained stationary. On bouillon the growth progressed rapidly and abundantly until there was a very heavy wrinkled film and growth for ½ inch up on the side of the flask.

These flasks of cod-liver extract inoculated with T. Bc. were not disturbed, and yet the growth progressed to a certain stage (three weeks) when it fell under the surface of its own weight, and ceased to grow. This could have been brought about either by a lower surface tension of the medium or by a different composition of the waxy capsule of the bacilli; we are inclined to think, from the morphological findings which we will describe subsequently that the latter view is more plausible.

In addition to the differences in the visible growth of the T. Bc. in vitro, microscopic examination of the bacilli after they had been on these different media for five weeks gave very interesting pictures. Preparations were stained by Gabbett's method and by the granule method previously described by one of us (Kieffer)[11] which stains the body of the bacillus a deep pink and the granules purplish black.

On Bogap, H 37 shows as long, slightly irregular bacilli, and with the granule stain the granules appear embedded in a well staining protoplasm, none of them being free. The glycerine potato shows the same characteristics, except that the bacilli are slightly smaller. But after growing for five weeks on the cold cod-liver oil potato the bacilli present a very marked change. They are smaller; with the Gabbett stain they appear beaded; some of them have a dumbbell shape (polar body appearance) and many single coccal-shaped acid-fast are seen. With the granule stain, the red-staining protoplasm is not very evident, the granules (giving the bead-shaped appearance to the bacilli) retain the violet color and appear as short chains of three or four; the bacilli having the dumbbell shape are seen to be composed of two granules united by a very thin short strand of red-staining protoplasm. Many isolated purple granules are seen, some with a very faint halo of pink, and occasionally a pink staining coccal-shaped form is seen.

In hot oil potato, the changes are essentially the same, although the protoplasm is slightly more evident. The latter is even more apparent on the refined oil potato.

On cotton-seed oil potato, the bacilli appear only slightly more granular with Gabbett stain than on glycerine potato, but with the granule stain little change can be detected from the picture given by the bacilli growing on glycerine potato.

On cod-liver extract potato the change is to the opposite. The bacilli appear shorter but with Gabbett stain more homogenous, only few of

them granular, and the granule stain shows that most of the bacilli are without granules, only a thin, short band of red staining protoplasm showing. The bacilli still showing granules contain relatively few of them.

The control tubes for cold oil and cotton-seed oil, in which the oil has been flooded over a growing culture of H 37 on glycerine potato, show the same changes as noted above for the particular liquid except that in the growth flooded with cold oil, the protoplasm is slightly more apparent than on the tube not turned over. Similar changes induced by cold oil were also shown with Norwich 5, Norwich 12 and Norwich 13 and Saranac Bovine. The latter bacilli were very small on glycerine potato and almost coccal on cold oil potato but yet were mostly composed of two granules in close juxtaposition.

These morphological changes were striking. L. Rogers [12] and G. R. Tambe [13] both record morphological changes of the T. Bc. in the sputum following treatment with sodium morrhuate, Tambe noting that "The bacilli themselves undergo degeneration, from the slight curved and unbroken appearance they become beaded and broken."

Guinea pig inoculations with the different growth of H 37 as well as of Saranac Bovine and of Norwich 5, 12 and 13 gave the following results:

All growth on ordinary, cotton-seed oil, and cod-liver extract media produced tuberculosis.

All growths on cod-liver oil media failed to produce tuberculosis.

The growths on glycerine potato subsequently flooded with cotton-seed oil and cold oil respectively produced tuberculosis. In this last instance one would not have expected the bacilli to produce tuberculosis, in keeping with results on other tubes of cod-liver oil potato, but the growth of T. Bc. was probably too thick to be permeated by the oil, a case similar to the experience of Kolmer et al[14] in testing the actions of chaulmoogra oil on growing culture of T. Bc. where they found that the bacilli submerged with chaulmoogra oil for twenty-four hours remained viable whereas Walker and Sweeney[15] report bactericidal action of chaulmoogra salts in dilution as high as 1 : 100,000.

These results although not conclusive, tend to show that the growths of the T. Bc. on potato soaked in cod-liver oil are very much inhibited and from the controls on cotton-seed oil we can deduce that at least part of the inhibitory action is caused by some constituent of the cod-liver oil and not altogether by a mechanical action of a film of oil between the bacterium and the medium, which by hindering or changing the manner in which pabulum is derived from the medium could cause changes of metabolism sufficient to account for the gross and microscopical changes.

We then started another experiment to see whether the action of the cod-liver oil was specific on the T. Bc. or whether it would affect similarly other acid-fasts and non-acid-fasts.

We used B. Typhosus as the non-acid-fast organism. At the same

time, and run in parallel series, two acid-fasts bacteria were used, namely:

A yellow lepra bacillus (obtained from the Phipps Laboratory), a yellow chromogenic, acid-fast, rapidly growing bacillus; and a strain of avirulent T. Bc., obtained from Dr. Sasano at the Trudeau Sanatorium Laboratory. This strain was isolated at post-mortem from a case of pulmonary tuberculosis from the public clinics at Cleveland, found virulent at first to guinea-pig, but soon found to have lost its virulence, to grow rapidly with a slight chromogenesis and at room temperature.

These three bacteria; B. Typhosus, yellow lepra and avirulent T. Bc. (Cleveland-Sasano), were grown on the following media similar to the one used in the previous experiment:

Glycerine broth potato
Glycerine agar
Potato soaked in cold cod-liver oil made by us
Potato soaked in refined cod-liver oil obtained locally
Potato soaked in cotton-seed oil
Potato soaked in cod-liver aqueous extract + glycerine
Cod-liver aqueous extract + glycerine
Cod-liver aqueous extract + glycerine agar

At the end of six weeks (the same length of observation as in the previous experiment) the results of growth were noted and smears were examined microscopically for morphological and staining reaction changes.

The curve of growth of all these strains on these different media followed very closely the curve of growth of the T. Bc. as shown in the charts, with the exception that the growths of B. Typhosus progressed for about ten days to the maximum growth on all the particular media and then practically stopped. The end results of the growths were as follows:

Very good growth of all strains on glycerine potato and glycerine agar.

Medium growth of all strains on cotton-seed oil potato.

No growth, or only slight growth, of all strains on the cold cod-liver oil potato (made here) and refined oil potato.

The growths of all strains on the cod-liver extract preparations were at about the same relative level and approximated the growths of the strains on cotton-seed oil potato.

The morphological changes of these strains after six weeks on the different media mentioned, as shown by Gabbett's and the granule (Kieffer's) methods, are not so definite as the changes exhibited by the T. Bc. under similar conditions, and they are more difficult to correlate.

It was seen that for the yellow lepra as a whole the protoplasm retained a faint purple color when treated by the granule method and that only on the cod-liver oil made here do they show true granules in a pink staining protoplasm; these latter bacilli also appear very granular by the Gabbett's method.

It was also noticed that a number of these organisms on some of the

media were completely decolorized by both methods (they lost their acid-fastness and took the counter-stain).

The changes of the Cleveland-Sasano strain of a virulent human T. Bc. were also varied. However, the most important change seen was the marked granulation shown by the bacilli grown on the cod-liver oil made here, both with Gabbett's and the granule methods. Complete decolorization of some of the organisms was also noted with this strain.

The cotton-seed oil did not change the granulations of the yellow lepra or the Cleveland-Sasano strains to any marked degree.

The changes produced by the refined-oil on the above two strains were similar to those brought about by the cod-liver oil made by us, but not quite so pronounced.

The B. Typhosus exhibited slight changes of morphology, the bacilli grown on the two cod-liver oil preparations showing very much more irregularity as to size and staining than any of the others, the growth on glycerine agar giving the most regular type. All the B. Typhosus completely decolorized by the Gabbett's, granule, and Gram's method.

Before summing up, one more remark about cod-liver oil is worthy of notice. Power and Parks et al[16] conclude their article on the "Prevention of Rickets by Sunlight," with the sentence, "The effect of sunlight and cod-liver oil on the growth and calcification of the skeleton and on the animal as a whole seem to be similar, if not identical." Which raises the question of the radioactivity of the cod-liver oil as an active agent in its therapeutic action.

We tested our different cod-liver oils (cold, hot and refined) for radioactivity by placing flasks filled with these different liquids over some light-protected, x-ray duplitized films, keeping them undisturbed for one week; at the end of that time the films were developed but no darkening of the emulsion attributable to the action of the oils could be seen.

Thinking that the glass of the flasks might absorb the rays a duplicate test was made by using, instead of glass flasks, containers made from the celluloid base of x-ray films, cleaned free from emulsion. The results were again negative.

SUMMARY AND OUTLINE OF FURTHER WORK

The work presented herein has been done in a laboratory with rather limited chemical resources and equipment, and we have not been able to do fractionation and chemical study of the cod-liver oil fatty acids and their esters to parallel the work done with chaulmoogra oil and necessary to isolate the constituent of the oil most active on the T. Bc. Our findings may not be accepted as conclusive evidence of the bactericidal power of true cod-liver oil, but at least they contain important suggestions to medical philosophers and important leads for the greater laboratories of the land, because:

1. In the manner in which they were used the cod-liver oils have had a definite inhibitory and bactericidal action on virulent tubercle bacilli;

cotton-seed oil, used for control, has not inhibited the growth of the organisms to the same marked degree, and has shown no bactericidal action; tubercle bacilli cultivated on the cotton-seed oil media for six weeks were able to grow and produce tuberculosis, whereas tubercle bacilli cultivated on cod-liver oil media for the same length of time were not able to grow when transplanted or to produce tuberculosis in injected animals.

2. Under the same circumstances, cod-liver oil has also inhibited the growth of a lepra bacillus, an avirulent T. Bc. and the B. Typhosus.

3. The aqueous extract of cod-livers has shown no true inhibitory or bactericidal action on the T. Bc. Whether it has any attenuating property in the long run, comparable to bile, remains to be seen.

4. The most interesting and definite findings have been the increased granular appearance and granulation of the T. Bc. and allied bacteria after contact with cod-liver oil, especially in view of the fact that similar changes have been observed in the bacilli from sputum of patients treated with sodium morrhuate. Cod-liver extract had the opposite effect on the tubercle bacilli.

5. Cod-liver oil extracted with as little heat as possible and not refined in any way seemed to have had a more potent action than commercial refined oil or oil extracted by heat. This would suggest that it is important that the source and manner of extraction of cod-liver oil and derivatives used in further research work be known.

6. If there is any radioactive property of cod-liver oil it is not sufficient to affect x-ray films exposed to it for one week. Investigations carried out with sensitive apparatus, the ionisation chamber for example, might show the cod-liver oil to have sufficient radioactivity for therapeutic and bactericidal action.

Further work on this study is in progress. We have prepared potassium salts (soaps) from our cod-liver oil, refined cod-liver oil, cotton-seed oil and chaulmoogra oil. Attempts to incorporate them in culture media have not been entirely successful so far except with the chaulmoogra soap, which we have incorporated in nutrient glycerine broth and agar in amount as great as 5 per cent. We intend to study the action of these soaps on the T. Bc. and other bacteria by different techniques to try to gain an accurate idea of their bactericidal, attenuating or inhibiting values, as well as to study the morphological and staining reaction changes brought about on the bacteria. We trust that further work along this line will at the same time give us some valuable data on the pleomorphism and life cycle of the T. Bc.

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ROUTINE USE OF GUINEA PIG TESTS IN SANATORIA

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The observations set forth in this paper describe in detail the results obtained in Nopeming Sanatorium by the use of guinea pig tests as an aid to diagnosis. Some of the diagnostic problems persistently presented in tuberculosis practice were solved or the solution promoted by this means. Moreover, the standard of study and investigation of cases in sanatoria may be raised by adding to the routine this procedure whose technique is neither expensive nor elaborate.

THE CARE OF GUINEA PIGS

The animals if carefully chosen of healthy stock thrive readily in any clean environment if supplied with temperate, preferably warm air and ventilation, and if furnished with food from which any refuse is excluded. The animals now in our caviary, grown from stock introduced seven years ago, have been practically free of sporadic disease and uniformly free of epidemic disease. Spontaneous tuberculosis or conveyance from cage to cage practically never occurs if ordinary precautions are taken. Besides supplying amply our own needs, several hundred of our animals have found ready disposition to private and public laboratories.

FECES TESTS

It is now a well known and generally understood fact that tubercle bacilli are usually present in the feces of open cases of pulmonary tuberculosis. This observation has been confirmed by Alexander;[1] Rittel-Wilenko;[2] Laird, Kite and Stewart;[3] Petroff[4] and others. Petroff found viable tubercle bacilli in the feces of all of thirty-two patients with open lesions. The method divised by Alexander simplifies the securing of positive results from the injection of feces into guinea pigs. Prior to the introduction of this method, it was difficult to keep the animals alive long enough for tuberculosis to become manifest. Many died of infection by one or another of the various organisms present in the specimen. By the use of the Alexander method this accident seldom occurs. In the series of fifty-one cases tabulated in this article, only five inoculated animals died of an infection other than tuberculosis, and in all five instances subsequent inoculation was successfully accomplished. Of the fifty-one cases considered, five had no sputum and forty-six had negative sputum. Among the five cases with no sputum, two were in-

fants with pulmonary disease, and in these cases the findings by inoculation were positive for tuberculosis. The remaining three comprised two tuberculosis suspects, and one patient with glandular tuberculosis. Ex-

Feces Tests

Case No.	Classification of cases	Sputum	Date of Inoculation	Date of Autopsy	Amount Injected	Findings
1496	Inc. C.	Pos.	3–8–21	4–26–21	.05 gm.	Positive
1551	Inc. C.	Neg.	5–9–21	7–4–21	.10	Negative
1519	Inc. C.	Neg.	5–19–21	7–4–21	.10	Negative
1554	Susp. Tb .	Neg.	6–1–21	7–4–21	.10	Positive
1600	Susp. Tb.	Neg.	7–28–21	9–13–21	.02	Negative
1588	Susp. Tb.	Neg.	7–29–21	9–13–21	.02	Negative
1596	Susp. Tb.	Neg.	8–3–21	9–13–21	.02	Negative
1607	F. A. C.	Neg.	8–3–21	9–3–21	.02	Negative
1543	Susp. Tb.	Neg.	8–5–21	10–5–21	.02	Negative
1570	M. A. A.	Neg.	8–10–21	10–7–21	.02	Negative
1603	Susp. Tb.	Neg.	8–14–21	10–7–21	.02	Negative
1586	Incip. C.	Neg.	8–27–21	10–12–21	.02	Positive
1457	F. A. C.	Neg.	8–27–21	10–12–21	.02	Negative
1565	M. A. A.	Neg.	8–29–21	10–12–21	.02	Negative
1598	Susp. Tb.	Neg.	9–15–21	10–25–21	.02	Positive
1618	F. A. C.	Neg.	9–16–21	10–25–21	.02	Positive
1621	Pulmonary abscess	Neg.	9–17–21	10–25–21	.02	Negative
1627	M. A. A.	Neg.	9–21–21	11–10–21	.02	Negative
1640	Bone Tb.	Neg.	10–11–21	11–10–21	.02	Negative
1629	Susp. Tb.	Neg.	10–14–21	11–10–21	.02	Negative
1336	Gland Tb.	Neg.	10–18–21	11–10–21	.02	Negative
1646	F. A. C.	Pos.	10–19–21	12–5–21	.02	Positive
791	M. A. C.	Neg.	10–28–21	12–5–21	.02	Negative
1625	Incip. B.	Neg.	10–28–21	12–5–21	.02	Positive
1643	Susp. Tb.	Neg.	11–1–21	12–19–21	.02	Negative
1616	Incip. C.	Neg.	11–10–21	12–19–21	.02	Negative
1241	Susp. Tb.	Neg.	11–10–21	12–19–21	.02	Negative
Out Pt.	Susp. Tb.	Neg.	11–14–21	12–19–21	.02	Negative
1104	Susp. Tb.	Neg.	11–15–21	1–13–22	.02	Negative
1638	Bronchiectasis	Neg.	11–16–21	1–13–22	.02	Negative
1610	Bone Tb.	Neg.	11–17–21	1–13–22	.02	Negative
1279	Bone Tb.	Neg.	11–18–21	1–13–22	.02	Negative
1652	Incip. A.	Neg.	12–6–21	1–14–22	.02	Negative
538	Susp. Tb.	Neg.	12–28–21	2–8–22	.02	Negative
1616	Incip. C.	Pos.	12–29–21	2–8–22	.02	Positive
1660	Susp. Tb.	Neg.	12–31–21	2–8–22	.02	Negative
1658	Incip. A.	Pos.	12–31–21	2–8–22	.02	Positive
817	Susp. Tb.	Neg.	1–4–22	3–8–22	.02	Negative
1659	Incip. A.	Neg.	1–18–22	3–8–22	.02	Negative
1639	Susp. Tb.	Neg.	1–19–22	3–8–22	.02	Negative
1663	Bone Tb.	Neg.	1–20–22	3–8–22	.02	Negative
1664	F. A. C.	Neg.	1–23–22	3–8–22	.02	Positive
1668	Gland Tb.	Neg.	1–28–22	3–14–22	.02	Negative
1678	Susp. Tb.	None	2–8–22	4–4–22	.02	Negative
1598	Susp. Tb.	Neg.	2–15–22	4–4–22	.02	Negative
1586	Incip. C.	Neg.	2–16–22	4–4–22	.02	Negative
1561	Incip. C.	Neg.	2–18–22	4–4–22	.02	Negative
1676	M. A. A.	Neg.	2–20–22	4–4–22	.02	Positive
1669	Incip. C.	Neg.	2–22–22	4–15–22	.02	Negative
1683	Incip. C.	Neg.	3–9–22	4–15–22	.02	Positive
1630	Incip. A.	Pos.	3–11–22	4–15–22	.02	Positive

Urine Tests

Case No.	Classification of cases	Sputum	Symptoms or signs referable to G. U. tract	Date of inoculation	Date of Autopsy	Amount injected	Findings
124	F. A. C.	Pos.	Absent	7–18–17	9–14–17	1 cc	Positive
474	M. A.	Neg.	Present	7–24–17	9–14–17	1 cc	Positive
654	F. A. C.	Pos.	Absent	7–24–17	10–1–17	1 cc	Negative
656	F. A. C.	Pos.	Absent	7–24–17	10–1–17	1 cc	Negative
334	M. A. A.	Pos.	Present	7–14–17	10–1–17	1 cc	Positive
767	M. A. A.	Pos.	Present	11–21–17	1–11–18	1 cc	Positive
392	F. A. C	Pos.	Present	12–22–17	2–7–18	1 cc	Positive
Pupil nurse		Neg.	Present	1–28–18	2–20–18	1 cc	Positive
1124	F. A. C.	Pos.	Present	7–17–19	8–27–19	1 cc	Positive
745	F. A. C.	Pos.	Present	7–18–19	8–24–19	1 cc	Negative
Out Pt.	no record.			9–12–19	10–23–19	1 cc	Negative
1365	F. A. C.	Neg.	Absent	5–29–20	8–1–20	1 cc	Negative
1196	F. A. C.	Pos.	Present	6–23–20	8–2–20	1 cc	Positive
1263	F. A. C.	Pos.	Present	6–24–20	8–4–20	1 cc	Negative
1377	F. A. C.	Pos.	Present	6–26–20	8–4–20	1 cc	Positive
1397	Susp. Tb.	Neg.	Absent	7–27–20	8–30–20	1 cc	Negative
1045	F. A. C.	Pos.	Absent	8–4–20	9–14–20	1 cc	Negative
1331	F. A. C.	Pos.	Present	8–6–20	9–14–20	1 cc	Negative
1413	F. A. C.	Pos.	Absent	8–19–20	10–3–20	1 cc	Negative
1421		Neg.	Present	8–28–20	10–3–20	1 cc	Negative
1282	F. A. C.	Pos.	Absent	8–28–20	10–3–20	1 cc	Negative
850	F. A. C.	Pos.	Present	8–31–20	10–3–20	1 cc	Positive
1381	F. A. C.	Pos.	Present	10–14–20	11–14–20	1 cc	Positive
1421		Neg.	Present	10–14–20	11–14–20	1 cc	Positive
1418	F. A. C.	Pos.	Present	10–27–20	12–8–20	1 cc	Negative
1283	F. A. C.	Pos.	Present	10–29–20	12–14–20	1 cc	Negative
1285	F. A. C.	Pos.	Present	10–30–20	12–17–20	1 cc	Positive
1472	F. A. C.	Pos.	Present	11–8–20	12–8–20	1 cc	Negative
1437	F. A. C.	Pos.	Present	12–9–20	1–9–21	1 cc	Negative
652	F. A. C.	Pos.	Absent	12–9–20	1–27–21	1 cc	Negative
1484	Susp. Tb.	Neg.	Absent	12–15–20	2–11–21	1 cc	Negative
1492	F. A. C.	Pos.	Present	12–23–20	2–15–21	1 cc	Negative
1490	F. A. C.	Pos.	Absent	12–23–20	2–16–21	1 cc	Positive
1238	F. A. C.	Pos.	Present	1–30–21	3–5–21	1 cc	Positive
1482	Susp. Tb.	Neg.	Absent	2–15–21	4–7–21	1 cc	Negative
1516	F. A. C.	Pos.	Present	2–16–21	4–7–21	.5 cc	Positive
Out Pt.	Susp. Tb.	Neg.	Absent	2–16–21	4–7–21	1 cc	Negative
1523	F. A. C.	Pos.	Present	3–8–21	4–23–21	1 cc	Positive
1496	Incip. C.	Pos.	Absent	3–8–21	4–26–21	1 cc	Positive
1519	Susp. Tb.	Neg.	Absent	3–12–21	4–26–21	1 cc	Negative
Nurse	Susp. Tb.	Neg.	Absent	3–15–21	4–26–21	1 cc	Negative
912	Gland Tb.	Neg.	Absent	3–17–21	5–5–21	1 cc	Negative
1505	Incip. C.	Neg.	Absent	3–17–21	5–5–21	1 cc	Negative
1504	M. A. A.	Neg.	Absent	3–24–21	5–5–21	1 cc	Negative
1532	F. A. C.	Neg.	Absent	3–31–21	5–5–21	1 cc	Negative
233	F. A. C.	Pos.	Absent	4–9–21	5–17–21	1 cc	Negative
1540	Bone Tb.	Neg.	Absent	4–9–21	5–17–21	1 cc	Negative
1531	Incip. A.	Neg.	Absent	4–27–21	6–3–21	1 cc	Negative
1534	F. A. C.	Neg.	Absent	4–28–21	6–13–21	1 cc	Negative
1535	M. A. A.	Pos.	Absent	4–27–21	6–13–21	1 cc	Negative
850	F. A. C.	Pos.	Absent	5–5–21	6–13–21	1 cc	Negative
1496	Incip. C.	Pos.	Absent	5–5–21	6–13–21	1 cc	Negative
1514	F. A. C.	Pos.	Absent	5–19–21	6–13–21	1 cc	Negative
637	F. A. C.	Pos.	Absent	5–21–21	7–4–21	1 cc	Negative
1493	F. A. C.	Neg.	Absent	6–13–21	8–2–21	1 cc	Negative

Urine Tests—Continued

Case No.	Classification of cases	Sputum	Symptoms or signs referable to G. U. tract	Date of inoculation	Date of Autopsy	Amount injected	Findings
1544	Bone Tb.	Neg.	Absent	7–12–21	8–19–21	1 cc	Negative
1552	M. A. C.	Neg.	Absent	7–12–21	8–19–21	1 cc	Negative
1577	F. A. C.	Neg.	Absent	7–13–21	8–19–21	1 cc	Negative
1515	Incip. C.	Pos.	Absent	7–13–21	8–19–21	1 cc	Negative
1639	Susp. Tb.	Neg.	Absent	10–15–21	11–10–21	1 cc	Negative
1651	F. A. C.	Pos.	Present	11–15–21	1–13–22	1 cc	Positive
1652	Incip. A.	Neg.	Absent	12–7–21	1–14–22	1 cc	Negative
1682	F. A. C.	Pos.	Absent	3–9–22	4–15–22	1 cc	Positive
1346	F. A. C.	Pos.	Absent	3–9–22	4–15–22	1 cc	Negative

amination of stained smears from the larynx was done in all these cases before resorting to guinea pig inoculation.

The sputum in the forty-six cases with negative sputum was diligently examined before and after the inoculation findings were recorded. In ten of this series the findings by feces inoculation were positive for tuberculosis. Subsequently, after an interval of from ten days to seven months (the latter in a child of five years) the sputum was found positive in eight instances. The sputum in two cases continued persistently negative. One of these patients remained in the sanatorium only a brief time, and the other was suffering from a remarkable

Sputum Tests

Case No.	Classification of cases	Date of Inoculation.	Date of Autopsy.	Amount injected.	Findings.
1479	Susp. Tb.	2–15–21	4–7–21	1 c. c.	Negative
1496	Inc. C.	2–8–21	4–27–21	.5 c. c.	Positive
Out Pt.	Susp. Tb.	3–16–21	4–29–21	1 c. c.	Negative
1513	F. A. B.	5–25–21	5–5–21	1 c. c.	Positive
1571	Susp. Tb.	6–14–21	8–2–21	.5 c. c.	Negative
1536	Susp. Tb.	6–14–21	8–2–21	.5 c. c.	Negative
1582	Susp. Tb.	6–16–21	8–2–21	.5 c. c.	Negative
1654	F. A. A.	12–23–21	1–27–22	.5 c. c.	Positive
638	Susp. Tb.	3–27–22	4–27–22	.5 c. c.	Positive
922	Susp. Tb.	3–27–22	4–27–22	.5 c. c.	Negative

Tests of Pus and Other Discharges

Case No.	Classification of cases.	Source and amount injected.	Date of inoculation.	Date of Autopsy.	Findings.
Out Pt.	Inc. C.	Pus from chest 1cc	2–8–21	3–24–21	Positive
Nurse	Susp. Tb.	Spinal fluid 1cc	3–15–21	4–26–21	Positive
Nurse	Susp. Tb.	Nasal discharge 1cc	3–17–21	4–26–21	Negative
1570	Incip. C.	Chest fluid 1cc	5–25–21	7–4–21	Negative
1340	M. A. A.	Chest fluid 1cc	9–2–21	10–25–21	Negative

spontaneous pneumothorax. Special comment is deserved by two cases in the series presenting negative sputum plus negative inoculation findings, one being a case of pulmonary abscess following pneumonia and the other a case of bronchiectasis.

URINE TESTS

Guinea pig inoculation with urine was practised in the sixty-four cases described in the appended table. The material injected was 1 cc. of urine, concentrated by the centrifuge. Twenty of these cases presented findings positive for tuberculosis. All of these save one had far advanced pulmonary tuberculosis, and sixteen of the twenty had signs or symptoms referable to the genito-urinary tract. Altogether thirty-six cases with far advanced pulmonary disease are tabulated, and with the twenty positive inoculation findings a fifty-five per cent. rate of coincidence of tuberculosis of the genito-urinary tract with far advanced pulmonary tuberculosis is established for this series.

SPUTUM TESTS

Sputum inoculations were made in ten cases in which the sputum was negative to repeated diligent examinations by usual staining methods. Four specimens gave findings positive for tuberculosis. The sputum in two of these cases was found positive later by ordinary examination: the other two cases had been positive before patients entered, but remained negative during residence.

TESTS OF PUS AND OTHER DISCHARGES

Inoculation findings positive for tuberculosis were demonstrated from pus in one case of pleural empyema and from spinal fluid in one case of tuberculous meningitis. Two cases of chest fluid and one case of nasal discharge yielded negative results.

SEWAGE TESTS

Systematic investigations of sewage effluent instituted several years ago was pursued throughout the year. Twelve monthly examinations by injections of effluent from the sewage disposal apparatus were recorded. Guinea pig inoculations with untreated effluent gave findings uniformly indicative of the presence of viable tubercle bacilli. However, injections of chlorinated effluent yielded negative findings invariably.

These results confirm the conclusions previously recorded and presented to this Association.

Sewage Tests

Source	Date of Inoculation	Date of Autopsy	Amount injected	Dilution	Result
Effluent from Imhoff tank treated with 11.2 parts of chlorine to 1,000,000 parts of effluent.				1 part effluent diluted with 9 parts of normal saline solution.	
Untreated effluent	1–27–21	3–5–21	1 cc	diluted as above	Positive
Chlorinated sewage	1–27–21	3–5–21	1 cc	undiluted	Negative
Untreated effluent	2–18–21	4–2–21	1 cc	diluted as above	Positive
Chlorinated effluent	2–18–21	4–2–21	1 cc	undiluted	Negative
Untreated effluent	3–22–21	5–17–21	1 cc	diluted as above	Positive
Chlorinated effluent	3–22–21	5–17–21	1 cc	undiluted	Negative
Untreated effluent	5–17–21	6–28–21	1 cc	diluted as above	Positive
Chlorinated effluent	5–17–21	6–28–21	1 cc	undiluted	Negative
Untreated effluent	6–9–21	7–13–21	1 cc	diluted as above	Positive
Chlorinated effluent	6–9–21	7–13–21	1 cc	undiluted	Negative
Untreated effluent	7–5–21	8–19–21	1 cc	diluted as above	Positive
Chlorinated effluent	7–5–21	8–19–21	1 cc	undiluted	Negative
Untreated effluent	8–1–21	9–13–21	1 cc	diluted as above	Positive
Chlorinated effluent	8–1–21	9–13–21	1 cc	undiluted	Negative
Untreated effluent	9–9–21	10–13–21	1 cc	diluted as above	Positive
Chlorinated effluent	9–9–21	10–13–21	1 cc	undiluted	Negative
Untreated effluent	10–8–21	11–10–21	1 cc	diluted as above	Positive
Chlorinated effluent	10–8–21	11–10–21	1 cc	undiluted	Negative
Untreated effluent	11–1–21	12–19–21	1 cc	diluted as above	Positive
Chlorinated effluent	11–1–21	12–19–21	1 cc	undiluted	Positive
Untreated effluent	12–8–21	1–14–22	1 cc	diluted as above	Positive
Chlorinated effluent	12–8–21	1–14–22	1 cc	undiluted	Negative
Untreated effluent	1–16–22	2–11–22	1 cc	diluted as above	Positive
Chlorinated effluent	1–16–22	2–11–22	1 cc	undiluted	Negative
Untreated effluent	2–7–22	4–4–22	1 cc	diluted as above	Positive
Chlorinated effluent	2–7–22	4–4–22	1 cc	undiluted	Negative

SUMMARY

1. Guinea pigs can be readily reared in any sanatorium.

2. The injection of feces should be used as a routine test for detecting the presence of tubercle bacilli when they are absent in the sputum.

3. Renal tuberculosis occurs more frequently in advanced cases than is ordinarily supposed. The routine injection from all patients in sanatoria is of value in securing early detection of renal tuberculosis. In patients without renal tuberculosis the urine usually does not contain tubercle bacilli.

4. The injection of negative sputum into guinea pigs should be used as a routine measure in addition to other methods of examining sputum.

5. Examination of the sewage of a tuberculosis sanatorium by injection into guinea pigs shows the presence of viable tubercle bacilli in the untreated effluent and the absence of viable tubercle bacilli in the effluent treated by chlorination.

THE PULMONARY ASPIRATION OF PARTICULATE MATTER*

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There have been many attempts to apply intrapulmonary medicinal therapy in diseased conditions of the lungs but they have uniformly resulted in failure either because they have proved of no avail after prolonged trial, or because they have been approached and applied without sufficient scientific data to denote just what the agent did and where it finally lodged and went to, after entrance into the air passages. Rosenberg's[1] intratracheal injection of medicinal agents for treating laryngeal and pulmonary tuberculosis survived for a short time only but even now has an occasional and sporadic supporter. The advent of the roentgen ray has helped to elucidate certain previously unknown factors in the gross distribution of substances such as inhaled dusts or injected fluids in the lungs but the finer details are not revealed even by this modern method. Thus also the bronchoscope has been used recently by Lynah[2] to diagnose and treat local diseased conditions in the lungs, but all this without the necessary information of what happens to the substance used, in this case bismuth subcarbonate and olive oil.

In spite of the failure of intrapulmonary medicinal therapy to date, may it not be that with further scientific observation and more complete data on the actual immediate and remote distribution of these medicinal agents and their effect upon the tissues, hope may still be entertained? Would it not be better to obtain more data on these points before applying all sorts of diagnostic and therapeutic intrapulmonary injections? It is true the scientific literature contains excellent articles on pneumoconiosis but not until recently has there been correlation between the upper and lower respiratory tracts. Truly a complicated mechanism is being dealt with which will require an immense amount of investigative work but some progress has been made.

Regarding the disposition of fluids containing particulate matter in the upper respiratory tract Corper and Enright[3] found that although the greater part of particulate matter (india ink and bacillus prodigiosus) entering by way of the eye is subsequently swallowed and passes into the gastrointestinal tract a small but definite portion of it finds its way into the

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Read by title.

larynx and trachea, where it may persist even as long as a week. In its passage from the eyes, the material traverses a definite channel dependent on which eye it has entered or into which it has been introduced, being found on the corresponding side of the nasopharynx and tonsil. Infectious material that is ingested is far less likely to enter the respiratory tract than that entering by way of the eye. More recently Bloomfield[4] in studying the dissemination of bacteria in the upper air passages found that sarcina lutea or charcoal particles implanted on various areas in the mouth and pharynx adhered at the site of inoculation. The ingestion of a large glass of water following inoculation did not seem to remove more than a very few of the organisms. Whatever the number removed, such organisms were swallowed with the ingested fluids and not reimplanted on other parts of the mouth or throat save for an occasional colony. Organisms inoculated on the side of the tongue traveled along the same side with practically no spread across the mid-line—organisms inoculated on the tonsil or pharynx did not come forward into the mouth.

About ten years ago Saito[5] in studying the quantitative absorption of dust from air with definite known dust content found that in animals 4 to 24 per cent. of the total amount of dust inhaled went into the respiratory apparatus, the remainder going into the intestinal tract, being caught in the nose and nasopharynx and then being swallowed; the total retained in the body being about 95 per cent. of the inhaled dust. Sneezing acts as a protection against the accumulation of dust in the animal body. In men[6] about 2 or less per cent. of white lead powder inhaled through the nose was exhaled again, about 51 per cent. remaining in the nose and 3 per cent. in the mouth; when inspired through the mouth about 80 per cent. was retained in the lung. Fluid droplets of solutions of potassium iodide, sodium chloride or sodium chromate may be absorbed to the extent of 96 per cent.[7] The exact site of absorption was not determined.

In 1920 Mullin and Ryder[8] rather surprisingly found that fluid suspensions of carbon and tubercle bacilli dropped into the nose of rabbits entered the lungs with great ease. "The technique was as simple as possible. The rabbit was held, usually on its back, with the nose elevated, and about 1 cc. of india ink or bacterial emulsion allowed to flow into one nostril from a pipette inserted just far enough to insure the fluid entering the nose." Thus they obtained almost entire blackening of the upper lobes of the lungs with many black spots irregularly distributed over the rest of the lungs especially when the ink was given a number of times. The tuberculosis obtained in the same way involved the upper and middle lobes when the rabbits were killed after seven weeks. The histologic distribution was not studied.

The intrapulmonary distribution and fate of inhaled solids-soot or dusts—has been elaborately studied on account of its enormous industrial and economic significance, not that opportunities for further observations in this direction do not exist. In an elaborate article on pulmonary an-

thracosis by Klotz[9] in 1914 some important points on the inhalation of carbon pigment (smoke) are emphasized. The deposition of carbon pigment in the lungs from the dust laden air is dependent upon the respiratory function and the activity of the lymphatics. The inhaled air with its carbon particles is carried to varying depths into the lung tissue. The major amount of the foreign material adheres to the moist walls of the respiratory passages and never reaches the lung tissue proper. It is possible and microscopical analysis seems to confirm this, that the foreign material that adheres to the mucus membranes of the nose, pharynx, trachea, and larger bronchi is but rarely carried into the tissues of these tracts but lying in the secreted mucus, is carried upwards and is eventually expelled. The relatively lesser quantities of dust and carbon which reach the lung alveoli also become adherent to the moist surfaces of the alveolar sacs and then by the activity of certain cells are eventually carried into the lymphatics of the alveolar wall where they are disposed of by the lymphatic system of the part. The subsequent distribution is to a great extent determined by the site of absorption within the lung. The tendency of the absorbed carbon is to pass from the finer lymphatic channels of the alveolar walls to the larger passages, eventually reaching a lymph node where the onward progress of the particles is impeded by the filtering action of this structure. In the main, the lymphatic drainage of the entire lung converges at the hilus and passes into the peribronchial glands located in this part.

Anthracosis in young adults is more prominent in the apex of the upper lobe, the anterior border of the upper lobe and the posterior border of the upper and lower lobes, but in these areas the distribution is by no means uniform. The unequal distribution of the pigment upon the pleural surfaces has no direct relation to the deposition within the lung. The lack of pigment upon the interlobar surfaces and in the rib grooves is only a superficial condition and does not affect the deeper underlying lobules. The earliest deposits are mainly in the perivascular lymphatics of the smaller branches of the pulmonary artery; subsequently pigment appears in the regions of the smaller bronchi and venules. In all of these situations, its presence becomes more marked with the increasing quantities of soot that are constantly inhaled. No evidence of excessive deposit in the deep tissues at the apex of the upper lobe was noted. More pigment was found toward the hilus than at the periphery, regardless of the pleural distribution. In acute pneumonia the involved areas show lesser pigmentation with a sharp line of demarcation from the more healthy tissues. In caseous pneumonia there is only a moderate amount of pigment deposit in the caseous areas. In localized chronic caseous tuberculous foci, in direct proportion to the amount of fibrosis, the pigment deposit increases. The fibrosed mass may become intensely black. It is probable, as was shown by Haythorn's experiments, that only these carbon particles lying within the alveolar sacs can reach a permanent interstitial abode and that little if any carbon is phagocyted and carried into the tissues from the bronchi or bronchioles. Furthermore, it would

appear, both from the experimental and other observations, that the carbon reaching the lung alveoli is only a very small portion of the carbon content of the air as inspired, and this portion has reached the lung because it escaped contact with the moist mucous surfaces of the respiratory tract. Carbon deposits by inducing fibrosis tend to encapsulate chronic tuberculous foci.

Haythorn[10] in reporting on the histological evidences of the disease importance of pulmonary anthracosis states

"the fine particles seem to gain entrance into the lung substance by way of the air passages, and as it has been stated by some that the mucous membranes of the nose, mouth, pharynx and larynx, trachea, bronchi and bronchioles contribute largely to the taking in of the pigment, but our observations tend to show that in this community (Pittsburg) at least, such is not the case. In the nasal cavities the vibrissae, and turbinates collect a great deal of carbon which is subsequently removed by the secretions, for in the examination of nasal polypi and strips of turbinate mucosa removed at operations we have never seen a single example of free pigment or pigment bearing cells beneath the epithelial layer....In the air passages below the larynx, pigment bearing cells have frequently been observed, but these are either free in the lumen or were surrounded by bits of mucus and other cells and were not found penetrating the epithelial layers."

The amount of pigment phagocytosis in the air passages above the lung alveoli must be a negligible quantity. Carbon pigment once taken up by the cells remains intracellular indefinitely unless freed by some process producing general necrosis of the tissues.

The phagocytic cells are not transient scavengers, but in a more leisurely manner gather their pigment load and transport it to the tissue spaces. The lining cells of the lung alveoli take little or no active part in the phagocytosis of carbon pigment. The process consists in the phagocytosis of the pigment within the lung alveolus by a cell, which is probably an endothelial leucocyte. The cell which takes the early active part in the formation of a tubercle is phagocytic for tubercle bacilli and for pigment granules and is probably an endothelial cell. The presence of pigment granules within these cells does not interfere with the cells taking part in the formation of a tubercle, in the usual way. The presence of pigment-bearing cells in the connective tissue about tuberculous lesions acts as an additional stimulus to fibrosis and encapsulation. The obliteration of the pulmonary lymph spaces in the anthracotic process is unfavorable for the local spread of tuberculosis, and aids in the localization of the condition. In acute inflammatory conditions where the lymphatics are important for proper resolution, anthracosis becomes seriously detrimental, because of the obliteration of the lymph spaces.

A great deal of experimental work has been performed to discover the origin and disposition of the characteristic and important epithelioid cell of the tubercle and the opinions have finally crystallized into the view taken by Foot[11] in his excellent recent studies which include experimental studies with india ink (carbon) and pulmonary tuberculosis.

His views which concur with those first expressed by Mallory and by Klotz and Haythorn are that the epithelioid cell is of definitely endothelial origin. There is little evidence that the local tissue elements take an active part in the process of tubercle formation, until after the lesion is formed; the reaction is, in a sense, exudative, since the lesion is produced from cells which migrate to the site of inflammation. The lymphocyte appears late and is not to be considered as a potential epithelioid cell; its presence in the tubercles is as yet unexplained. Experimental tubercles are formed in the lung primarily by cells originating in the capillary endothelium. These cells are probably present in small numbers in the normal lung, lying free both in the alveolar wall and the air vesicles. In response to infection they proliferate in the capillary walls in the vicinity of the invading organisms, migrate in steadily increasing numbers, and, arriving at the site of the infection, further multiply and to some extent fuse to form the syncytia known as giant cells. The epithelial cell takes no active part in the process; its proliferation tends to repair denuded surfaces and is regenerative rather than combative or phagocytic in nature. This cell does not take up carbon (particulate matter), in contradistinction to the endothelial cell. The cells of endothelial origin not only phagocytose tubercle bacilli, but carry them into the tissues, for example into lymph nodes, by way of the lymphatics, or into other lung lobules by way of the air passages in which they are readily demonstrable. Foot's studies were made on experimental subcutaneous tubercles in which the india ink and tubercle bacilli were injected together; experimental pulmonary tuberculosis produced by the intratracheal injection of tubercle bacilli and carmine suspension, and the intravenous injection of india ink; and experimental general miliary tuberculosis produced by the intravenous injection of tubercle bacilli and india ink. The conclusions as to the endothelial origin of the phagocytic cells of the lung tissue coincide in every way with those expressed by Permar[12] who also emphasizes the non-participation of the epithelium in these phenomena of phagocytosis.[13]

In hope of being able to utilize the intratracheal route for the more direct application of therapeutic agents in pulmonary inflammatory conditions and to elucidate certain phases of pulmonary edema Winternitz and Smith[14] studied the absorption of fluids from the lungs and found that high quantities of fluid can be introduced through the trachea without untoward effects. In acute inflammatory processes fluid in the pulmonary parenchyma may be a means of disseminating the infection through the lung tissue. A considerable period of time may be necessary before fluid (isotonic salt solution) introduced into the alveoli of the lung is entirely absorbed. After 18 hours much has disappeared and within 4 days it has been absorbed without a trace. Inert foreign material can be washed out by the method of intratracheal pulmonary irrigation, but even after prolonged treatment of this kind, in which many liters of irrigating fluid are employed, there still remains a residue of the original

material introduced. A non-lethal dose of virulent pneumococci introduced into the lungs of rabbits followed by irrigation resulted in a very diffuse and fulminating lobar consolidation. Irrigation with salt solution not only cannot be utilized to advantage, but is actually a disseminator and an aggravator of the inflammatory process within the lung.

Even though histologic studies of the distribution of aspirated fluids containing particulate matter were not available, roentgenologic studies in man and experimental animals have been recorded. In 1917 Waters, Bayne-Jones and Rowntree[15] forcibly injected into the trachea of dogs a 10 per cent. suspension of iodoform in olive oil under ether anesthesia with the animal lying on its abdomen. Dissection showed the material apparently in the same degree of suspension in the bronchi, bronchioles and smallest air passages. Micro sections showed large masses of fat filling the alveoli. The position of the catheter in the trachea determined somewhat the distribution of the fluid. The plates showed that the bronchioles of the upper lobes and the alveoli of the apices were filled when the injection was made into the lower third of the trachea. The mixture produced a proliferative broncho-pneumonia.

In view of the belief of Klotz and his co-workers that carbon enters the lung parenchyma only through the alveoli, it seems well to call attention to the fact that bacteria may act slightly differently at times since Winternitz, Smith and Robinson[16] have found that pneumonococci can enter the tracheal lymphatics through a damaged epithelium and spread by way of the lymphatics to the lung. The lymphatics of the submucosa of the trachea afford a direct pathway of infection to the lung. The submucosa of the trachea contains a rich plexus of lymphatics, prominent everywhere and devoid of valves. Although this lymphatic system provides a pathway for infection, it may also serve as a protective mechanism against pulmonary infection, for the drainage of the submucosa of the trachea and bronchi is largely diverted as the lung is approached to the protecting regional lymph glands. They divide the pneumonias into two groups: namely, those secondary to damage of the protective mechanism of the upper respiratory tract, and those in which such damage was not demonstrable. No explanation has been suggested for the latter except that the pathway of the microorganisms was through the lumen of the trachea and bronchi.

The studies to be reported were initiated a number of years ago to obtain information upon the feasibility of applying medicinal therapeutic agents directly to diseased foci in the lungs. Two methods of approach were considered at that time, the inhalation of particles suspended in air which might be subsequently dissolved in the lungs to exert a local action, and the inspiration or aspiration of liquids or liquid suspensions which could be introduced and the particles remaining, exert an action upon the diseased focus in the lungs. Since, however, the literature at that time gave little information on the immediate distribution of inhaled or aspirated fluids except that cited above, it was decided

to study this more fully by using a comparatively inert substance—carbon in dust-like suspended form inhaled with air, and the same substance suspended in liquid form (india ink). At that time the intratracheal injection of the liquids only was considered. Carbon had the advantage over many other substances in that it was easily discernable both macroscopically and microscopically even though a disadvantage existed in that a spontaneous anthracosis occurs in experimental animals especially of advanced age which might complicate the findings. This, however, did not prove to be the case in determining the immediate distribution since the dust inhaled spontaneously never was sufficient to confuse with the findings which proved of greatest significance in this study. The anthracotic spontaneously inhaled dust also was found to be intracellular and only became a source of confusion when considering the source of the intracellular pigment deposits.

THE INHALATION OF SOOT IN NORMAL AND TUBERCULOUS ANIMALS

For the inhalation of carbon suspended in air a glass box was constructed, with glass walls and top and wood floor, so that the animals could be observed during the entire period of exposure to the smoke or soot. The box had ample side ventilation for a sufficient supply of fresh air and a suitable hole in the bottom for the entrance of the smoke prepared by burning camphor. Although it was impossible to make conditions absolutely uniform regarding the density of the smoke inhaled, fair uniformity was obtained by admitting smoke into the chamber until the animals began to show discomfort and become restless. The smoke was then permitted to remain for the allotted time of inhalation or until it had almost entirely dispersed, when it was replaced by again burning camphor, under the smoke inlet hole. In this way a very fine suspension of carbon in air was produced and of sufficient density not to permit vision through the exposure box which was about fifteen inches wide. White mice, guinea pigs and rabbits were exposed to the air laden with smoke for varying times, after which the lungs were examined macroscopically and microscopically to determine the immediate and subsequent distribution of the carbon.

Experimental Data

Experiment 1. Three normal white mice were placed in the glass exposure box and smoke admitted at fifteen minute intervals for three hours. One mouse died at the end of this time and the remaining two were killed. Macroscopic examination revealed no visible carbon, while microscopic examination of sections showed small deposits of carbon in the larger air passages probably as far down as the bronchioli respiratorii.[17] The deposits were especially conspicuous on many projections and constrictions of the larger air passages as seen in ordinary histologic sections. The finer lung divisions—the alveoli—were free from carbon deposits of any kind.

Experiment 2. Four normal white mice were exposed to the camphor-smoke for thirty minutes on three successive days after which the lungs were examined. Macroscopically the carbon pigment was not visible, while microscopically carbon deposits were seen in many, although not all, of the larger air passages (bronchi) being heavy and especially conspicuous on the projections seen at bifurcations and constrictions as seen in histologic sections. The alveoli were free from any visible free carbon particles, although an occasional phagocytic cell containing from one to three granules was seen on the alveolar walls and interstitially, which may easily have had nothing to do with the experiment.

Experiment 3. A duplicate of experiment two except that the four mice were permitted to inhale camphor-smoke thirty minutes daily for ten days after which the lungs were examined but the naked eye could not discern any appreciable deposit in the lungs. Microscopically the carbon deposits resembled those in experiment two, being especially prominent on tissue projections in the larger air passages where carbon containing phagocytic cells were seen both on the epithelial surfaces in the vicinity of the deposits and deeper in the tissues. In some of the alveoli a very thin deposit of carbon lined the wall but this was not universal nor regularly distributed, it being rather confined to a small proportion of the alveoli seen in an entire section. Phagocytic cells containing moderate amounts of carbon are seen sparsely in the alveoli and in the alveolar walls. This is the first mouse specimen in which sufficient camphor-smoke had been inhaled to obtain an appreciable deposit of carbon on the alveolar walls. As compared to the larger air passages the deposits in the alveoli are, however, small in amount.

Experiment 4. A duplicate of experiment two and three except that the four mice were permitted to inhale camphor-smoke thirty minutes daily for thirty-two days and the lungs examined one day after the last inhalation. The lungs appeared uniformly pigmented with carbon to the naked eye and the deposit seemed slightly more marked on the external pleural surfaces of the upper lobes than elsewhere. Microscopically there are dense deposits of carbon in the larger air passages, more commonly seen as above and heaped upon the projections at bifurcations. The deposits are, however, seen extending further into the bronchioli respiratorii (Miller) and their terminal alveoli, but being rather filmy in nature lining the alveolar walls and not reaching the point of actual dense deposits. There are numerous phagocytic cells containing very fine granules of carbon in the alveoli especially that contain free carbon, and interstitially in the alveolar walls and the walls of the bronchioli respiratorii. Some carbon phagocytic cells are also seen in the larger respiratory passages, more prominent in the vicinity of carbon deposits, and in their wall. The source of these pigment cells, whether from the larger air passages or alveoli is difficult of determination from these sections. The perivascular lymphoid collections do not seem heavily laden with carbon pigment cells.

Experiment 5. Two young normal guinea pigs were exposed to camphor-smoke for thirty minutes on three consecutive days after which the lungs were examined. Macroscopically the carbon pigment was not visible; microscopically, however, the findings resembled those seen in the short periods of inhalation in the mice, the carbon being confined mainly to the larger air passages and the heaviest deposits being seen at the projections at bifurcations as seen in histologic sections.

Experiment 6. Two young normal guinea pigs were exposed to camphor-smoke for thirty minutes on ten consecutive days. Macroscopically the carbon was seen fairly uniformly distributed while microscopically it was mainly confined to the large air passages except for an occasional area where it was found in the bron-

chioli respiratorii, with a thin film on the walls of the alveoli. Carbon stippled cells with few phagocyted particles are seen sparsely in the alveoli and alveolar walls, as also in the larger air passages and their walls—their origin or source could, however, not be determined definitely in the sections.

Experiment 7. A duplicate of experiment 6 in which two guinea pigs were exposed to the camphor-smoke laden air for thirty minutes daily for twenty-eight days. The animals were in poor condition at this time. Microscopically the lungs did not differ much from those of experiment 6 except that more carbon was found in the alveoli and there were inflammatory changes with intraalveolar hemorrhages.

Experiment 8. Three young normal rabbits were exposed to air containing camphor-smoke, one for thirty minutes on three consecutive days, one for thirty minutes on ten consecutive days and one for thirty minutes on thirty consecutive days and although slight variations occurred from the findings noted in white mice and guinea-pigs, they agreed fairly well as a whole. In the shorter exposure periods the deposits of carbon were confined mainly to the larger air passages—bronchi and bronchioles—being irregularly distributed, and were heaviest on projections and constrictions seen at bifurcations where they were accumulated in a cap-like histologic form, as the period of exposure was extended the deposits in these localities became heavier and in addition fine carbon deposits were found lining the alveolar walls having extended deeper into the bronchioli respiratorii. Carbon pigment phagocytic cells were sparsely found in the alveoli and larger air passages, especially in the vicinity of the carbon deposits, and in the alveolar and bronchial walls.

Experiment 9. Two rabbits were given intravenously 1.5 mgm. of bovine tubercle bacilli in fine suspensions and twenty-one days later were allowed to inhale for thirty minutes daily camphor-smoke. One of these rabbits died eleven days after the inhalations were initiated and presented a well defined miliary tuberculosis but no anthracosis, and microscopically although there were a few carbon pigment cells in the vicinity of some of the miliary tubercles, the majority were free from such cells. Carbon deposits were found in the larger air passages localized as in the previous normal rabbits. The lungs of the second rabbit was examined after 32 days of inhalation and a rest of three days. Both lungs had numerous macroscopic miliary tubercles about half of which had deposits of carbon around them, some entirely encircling the tubercles and some with deposits eccentrically located.

Microscopically typical miliary tubercles were found, many without any visible carbon deposits; where the carbon deposits were most evident this was intracellular, being seen in heavily carbon stippled phagocytic cells that had accumulated around the tubercle and on its periphery, lying thickly accumulated in the alveoli. It seemed that these cells had wandered to the site of the tubercle from adjacent areas, since nowhere in the normal lung tissue or alveoli were more than sparse collections of carbon containing cells seen. The entire carbon around the tubercles was intracellular. The fate and source of these cells, whether they come from adjacent alveoli or pulmonary tissue, even though their endothelial origin is concurred in, remains for subsequent studies to determine.

These observations on the inhalation of carbon in the form of smoke prepared by burning camphor indicate that the immediate and early localization in the lungs of the three species of animals tested, mouse, guinea pig and rabbit, is in the larger air passages. It accumulates and deposits

on the projections into the lumen of these passages, especially at bifurcations and sudden elevations formed by a change in the course of the bronchi. As inhalation of the smoke continues, the deposits in the bronchi increase in amount; a comparatively small part of the carbon is deposited in the bronchioli respiratorii (Miller) and their terminal alveoli irregularly distributed as a fine layer covering the epithelial linings. At this time a few phagocytic carbon cells begin to appear in the alveoli and interstitially stippled with varying grades of the pigment. In the lungs of rabbits that have inhaled carbon smoke for a long time (32 days) progressive miliary tubercles become surrounded by phagocytic cells containing carbon granules but the deposit is by no means regular or constant, although some tubercles may be entirely surrounded by these cells. The cells containing carbon accumulate in the alveoli surrounding the tubercles, the number being in marked contrast to those seen sparsely scattered in the alveoli and alveolar walls of the uninvolved parts of the lung. Their immediate source whether from adjacent alveoli or tissues could not be established, although their endothelial origin is concurred in.

THE PULMONARY INSPIRATION OR ASPIRATION OF LIQUIDS

In view of the observations on pulmonary irrigation by Winternitz and Smith, the uniform distribution of oil and iodoform injected intratracheally as noted by Waters, Bayne-Jones and Rowntree, and the ready access from the upper to the lower respiratory tract as noted by Mullin and Ryder, it seemed that further observations were needed on the pulmonary distribution of fluids injected intratracheally, and aspirated into the lungs after nasal instillation. The observations were made in a systematic manner in that the intratracheal injections of small amounts of fluid were first tried, later to be followed by the inspiration or aspiration of the same fluids. Two fluids were used, a suspension of barium sulphate in physiologic saline, and india ink. The distribution of the former was observed by making roentgenographs and of the latter by direct examination of the lungs after gassing the animal. The former method possessed the advantage of making possible a series of observations on the same animal, although in the later case direct observation gave more detailed information.

Experimental Data

In the following experiments barium sulphate suspension (about 10 to 20 per cent.) in amounts of 1 to 5 cc., or india ink (Higgins Eternal Ink) 1-3 cc. were injected intratracheally either by a syringe, or dropped through a tracheotomy tube in rabbits.

Experiment 1. Rabbit 1. Received barium sulphate injected into the trachea by syringe while lying on its back and shortly thereafter a roentgenograph was taken

which revealed the barium rather more densely deposited on one side of the chest than the other, the distribution not exactly being uniform throughout.

Rabbit 2. A duplicate of 1. given barium sulphate by intratracheal injection also revealed an irregular distribution of the barium in the chest, confined mainly to one side on the roentgenograph taken five minutes after injection. Thirty minutes later, eighteen hours later and twenty-four hours later there was very little change in the distribution of the barium.

Experiment 2. Rabbit 3. Received barium sulphate suspension dropped into a tracheotomy tube while lying on its back and fifteen minutes later the roentgenograph revealed a fairly uniform distribution of the barium throughout both lungs.

Rabbit 4. Received barium sulphate suspension dropped into a tracheotomy tube while lying on its back and fifteen minutes later the roentgenograph revealed an irregular distribution of the barium, being stippled and more dense at the base of the lung on one side of the chest.

Rabbit 5. Received barium sulphate suspension dropped into a tracheotomy cannula while lying on its back and fifteen minutes later the roentgenograph revealed an irregular distribution of the stippled barium opacity, it being more dense at the base of the lung and on one side of the chest.

Rabbit 6. Received barium sulphate suspension injected into the trachea by syringe, while lying on its back and ten minutes later the roentgenograph revealed an irregular stippled opacity in both lungs more dense towards the hilus.

Rabbit 7. Received barium sulphate suspension injected into the trachea by syringe while lying on its back and fifteen minutes later the roentgenograph revealed an irregular stippled opacity, it being more dense in the region of the hilus and on one side of the chest.

In view of Mullin and Ryder's findings given in the literature resumé barium sulphate suspension was dropped into the nose of three rabbits lying in the horizontal posture and roentgenographs were made at intervals of from five minutes to one hour but all proved negative. The peculiar tendency toward one side distribution of the barium suspension made it seem advisable to inject the barium sulphate suspension while the rabbit was lying on either the right or left side to note the effect.

Rabbit 8. Received an injection of a suspension of barium sulphate by syringe into the trachea while lying on the left side and a roentgenograph taken thirty minutes later revealed a uniform stippling by the opaque barium throughout the entire left lung.

Rabbit 9. Received a suspension of barium sulphate dropped into a tracheotomy tube while lying on the left side; a roentgenograph taken thirty minutes later revealed the opaque barium uniformly stippling the entire left lung.

Rabbit 10. A duplicate of Rabbit 8 except that the animal was lying on the right side while the barium suspension was being injected, revealed in a chest roentgenograph taken thirty minutes after injection, a uniform opaque stippling of the lower lobes of the right lung, the right apex in this case being fairly clear.

Rabbit 11. A duplicate of Rabbit 9 except that the animal was lying on the right side while the barium suspension was being dropped into the tracheotomy tube, revealed in a roentgenograph taken thirty minutes later a uniform opaque stippling of the right lung.

THE PULMONARY ASPIRATION OF CARBON IN FLUID SUSPENSION AFTER NOSE INSTILLATION UNDER VARIOUS CONDITIONS

After obtaining negative findings roentgenologically in the lungs of rabbits that had been given nasal instillation of suspensions of barium sulphate while in the horizontal posture with head elevated so the fluid could be easily dropped into the nose, the more delicate method of using india ink instead of barium sulphate suspension, and direct postmortem examination of the lungs was resorted to. About 10 rabbits were used in this experiment but in spite of the use of comparatively large amounts of india ink—10 to 20 cc. instilled into the nose—the results obtained were uniformly negative.

It was then discovered that under ether anesthesia with the animal lying in the horizontal posture on its back even a few cubic centimetres of india ink dropped into the nose, when the head was slightly elevated, easily entered the lungs* where in certain cases the moist râles produced by the ingress of the liquid and its movement in the lungs could be felt by merely holding the hand firmly against the chest wall.

In order to correlate the findings in which the distribution of the barium sulphate suspension injected intratracheally was found to be dependent upon posture, with the distribution of inspirated or aspirated india ink after nose instillation, the following experiments were planned.

Experiment 1. Rabbit 1. was given ether to the point of complete anesthesia, lying on its back, when three cc. of india ink was dropped into the right nostril, while the head was slightly elevated. The ink was readily inspired as given and within a few minutes râles could be felt in the chest. The anesthetic was discontinued and the animal allowed to recover. One half hour later the lungs were examined and the carbon pigmentation was found to be irregularly distributed in discrete spots of varying sizes mainly in the posterior portion of the lungs, on both sides, slightly more in the middle and upper portions of the lungs.

Rabbit 2. A duplicate of Rabbit 1. revealed a distribution differing only in detail from that found in Rabbit 1, the major part of the carbon pigment being seen posteriorly.

Rabbit 3. Was placed under ether anesthesia and laid on the right side in the horizontal position, with the head slightly elevated. Three cc. of india ink were dropped into the right nostril and in a few moments it could be heard in the pharynx and trachea producing the typical rattling so frequently heard during prolonged anesthesia and in moribund consumptives. A little later râles could be felt in the chest. The animal was allowed to recover and thirty minutes after nasal instillation of the ink, the lungs were examined. The black carbon deposits were found mainly in the lower portion of the right upper lobe and in discrete spots in the middle lobe. The accessory lobe also contained carbon, but the remainder of the lungs were fairly free from it.

Rabbit 4. A duplicate of Rabbit 3 treated in the same manner except that the

* This was kindly demonstrated to one of us (Robin) by Dr. C. T. Ryder during a visit to learn the technic employed in his work.

india ink was dropped into the left nostril. The results obtained in the lungs, although differing slightly as to detailed distribution, agreed well with that found in Rabbit 3, the major part of the ink being found in the upper lobe of the right lung.

Rabbit 5. A duplicate of Rabbit 3 except that the anesthetized rabbit was lying on the left side in the horizontal posture during the right nasal instillation of three cc. of india ink. Throughout this experiment the animals were kept on the side required for at least five to ten minutes after nasal instillation, and thirty minutes allowed for recovery from the anesthetic before the animal was given illuminating gas, and the lungs examined. The carbon pigment in Rabbit 5 was found mainly in the lower portion of the upper lobe of the left lung with occasional discrete spots in the other portions of the left lung. The right lung was uniformly free from any carbon deposits.

Rabbit 6. A duplicate of Rabbit 5 except that the 3 cc. of india ink were dropped into the left nostril while the anesthetized animal was lying on the left side with head slightly elevated. The distribution of the ink in the lungs agreed well with that found in Rabbit 5, it being mainly confined to the upper lobe of the left lung, to the accessory lobe, with a few discrete spots in the middle lobe of the right lung.

A number of rabbits were given only 0.5 to 1 cc. ink and in the majority of these the ink also readily entered the lungs.

The same findings were obtained in dogs given nasal instillations of india ink while anesthetized and lying in the horizontal posture.

Dog 1. Was given ether to complete anesthesia and while lying in the horizontal posture on the right side 5 cc. of india ink was dropped into the right nostril with the head slightly elevated. The animal was allowed to recover from the anesthetic and 30 minutes after the nasal instillation was gassed and the lungs examined. The carbon pigment was found entirely in one large patch in the lower portion of the upper lobe of the right lung.

Dog 2. A duplicate of Dog 1 except that the india ink was dropped into the left nostril while anesthetized and lying on the right side. The carbon pigment was found in the right upper lobe with a few discrete spots in the middle lobe.

Dog 3. Was anesthetized and india ink (5 cc.) dropped in the right nostril while lying in the horizontal posture and with the head slightly elevated. The carbon pigment was confined to the middle and lower portions of the upper lobe of the left lung.

Dog 4. A duplicate of Dog 3 except that the india ink was instilled into the left nostril during anesthesia and while the animal was lying on the left side. The carbon pigment was found predominantly in the left lung and in the upper lobe as in Dog 3.

On account of the difficulty experienced in attaining a pulmonary inspiration or aspiration of india ink instilled into the nose of normal rabbits or dogs in the normal horizontal posture, this was tried in these animals while in the vertical posture.

Rabbit 7. Was placed in the vertical posture with head extended and up, and about 5 cc. of india ink was dropped into the right nostril. A few moments after instillation it could be heard gurgling in the pharynx and shortly thereafter following slight difficulty in respiration it could be felt as fine moist râles in the chest. An examination of the lungs after giving the animal illuminating gas revealed the carbon pigment, mainly in the lower lobe of the left lung as multiple discrete black spots, a few being found in the upper lobe; the right lung was comparatively free from black pigmentation.

Rabbit 8. A duplicate of Rabbit 7, held in the vertical posture and 5 cc. of india ink dropped into the left nostril. An examination of the lungs 30 minutes after nasal instillation of the india ink revealed a dense accumulation of black pigmentation in the base of the left lung posteriorly, with discrete spots of pigment in the lower portion of the upper lobe of the same lung and at the base of the right lung.

Rabbit 9. A duplicate of Rabbit 7 held in the vertical posture and 5 cc. of india ink dropped into the right nostril. An examination of the lungs 30 minutes after instillation revealed the carbon posteriorly in both lower lobes, more marked at the base on the right side. There were a few discrete spots posteriorly in the lower portion of the upper lobe of the right lung.

Rabbit 10. A duplicate of Rabbit 7 held in the vertical posture and 3 cc. of india ink dropped into the right nostril. An examination of the lungs 11 days after instillation revealed the carbon mainly in the right lung in the lower border of the upper lobe and in the lower border of the middle lobe, and in discrete spots in the lower lobe. A typical acute lung abscess was found in the posterior middle of the lower lobe of the right lung. A few small discrete deposits of pigment were found in the upper portion of the lower lobe of the left lung.

The accessory lobe in the above three animals frequently contained carbon although its presence could not be exactly correlated with definite conditions.

The above experiments were duplicated in dogs in the vertical position though with not as great ease.

Dog 5. Was held in the vertical position head extended and up, while about 30 cc. of india ink was rapidly dropped into the right nostril (previous preliminary experiments in which only 1 to 5 cc. were used uniformly were negative). The animal succeeded in swallowing most of the ink but a small amount of it reached the trachea as seen in examination of the lungs 30 minutes after nasal instillation. A fine black carbon stippling was found in the upper posterior portion of the lower lobe of the left lung.

Dog 6. A duplicate of Dog 5 held in the vertical position while about 20 cc. of india ink was dropped into the left nostril. The carbon pigment was found posteriorly in the middle portion of the lower lobe of the left lung as three discrete spots, stippled in appearance.

Dog 7. A duplicate of Dog 5 in which the india ink was dropped into the right nostril while in the vertical posture, revealed the ink in the right lower and middle lobes posteriorly as discrete spots.

The above studies seem to indicate that liquids containing particulate matter in suspension (india ink) when inspired or aspirated into the lungs from the upper air passages after nasal instillation reach an intrapulmonary localization dependent upon the posture of the animal during the inspiration or aspiration of the fluid. When in the horizontal posture and under an anesthetic the particulate matter is found mainly in the upper lobes of the lungs and on the side upon which the animal was lying when the liquid entered the lungs; lying on the back the particulate matter is found in the posterior portion of the lungs and may be found in both lungs or only on one side. In the vertical posture the tendency is for the liquid to localize in the lower lobes and commonly at the base.

Thus far no attempt has been made to determine how long the particulate matter inspirated or aspirated into the lungs from the upper air

passages after nasal instillation remains in the lungs except that in the one experiment cited above it was found after 11 days' residence in the lungs.

Experiment 2. Twelve normal rabbits were used in this experiment. About 5 cc. of a diluted (1:1 with warm water) Higgins Eternal Ink was dropped into the nose while the animal was in the vertical position with head up and extended.

Rabbit 1. Examined 8 days after nasal instillation revealed a large amount of carbon pigment in the lungs, irregularly distributed in discrete spots mostly in the lower and middle lobe of the right lung, but also in the left lung.

Rabbit 2. Examined 13 days after the nasal instillation of the india ink revealed the carbon pigment in the posterior part of the lower lobe and lower border of the upper lobe of the left lung, and in the posterior portion of the lower lobe of the right lung, as speckled discrete deposits. The accessory lobe was also speckled with carbon deposits.

Rabbit 3. Examined 21 days after nasal instillation of the india ink revealed the carbon deposits posteriorly throughout the base of the lower lobe of the left lung; the lower lobe of the right lung was speckled posteriorly in its mid part.

Rabbit 4. Examined 5 weeks after nasal instillation revealed the carbon pigment mostly in the right base, but also in discrete spots in the posterior portion of the left lower lobe.

Rabbit 5. Died 5½ weeks after nasal instillation and revealed the carbon deposits in discrete spots posteriorly in the lower lobe of the left lung, and in the middle and lower lobes of the right lungs.

Rabbit 6. Examined 6½ weeks after nasal instillation revealed the carbon pigment in stippled form throughout the entire lower lobe of the left lung with a few spots posteriorly in the upper lobe, and the lower portion of the right lower lobe.

Rabbit 7. Examined 9 weeks after nasal instillation revealed the discrete carbon spots posteriorly in both lower lobes with a few spots in the lower portion of the right upper lobe.

Rabbit 8. Examined 12 weeks after nasal instillation revealed the discrete carbon spots, with no apparent tendency to vanish, in the posterior and middle portions of the right lower lobe, in the lower portion of the right upper lobe and in the posterior basal portion of the left lower lobe.

Rabbit 9. Examined 15 weeks after nasal instillation revealed the discrete carbon spots along the posterior border of the entire right lung and irregularly throughout the lower lobe and lower border of the upper lobe of the left lung. There did not seem to be any distinct vanishing of the carbon pigment, at least it was not evident to the naked eye. Three of the rabbits in this experiment are still alive and will be reported on subsequently. It might be added also that rabbits lying on their back with head elevated and extended and body at an angle of 45 degrees to the horizontal would readily inspire the india ink after nose instillation of about 5-10 cc. This was tried with success in six rabbits.

A number of the above rabbit lungs were studied histologically to determine the finer distribution of the inspired or aspirated fluid (india ink) containing particulate matter.

1. For the purpose of determining the immediate minute distribution

of the india ink inspired from the upper respiratory tract after nasal instillation microscopic sections stained with haematoxylin and eosin were made from the lung of a normal rabbit 20 minutes after the instillation of ink under ether anesthesia. In the larger air passages the carbon is found in accumulations along the smooth walls with no tendency to mass on projections. It is also seen in distinct accumulations in the finest air sacs, the alveoli. It is not uncommon to find the carbon completely filling alveoli.

2. Sections taken from the lung 30 minutes after nasal instillation of india ink from a normal rabbit while in the vertical posture, not anesthetized, revealed the ink in the finer air passages and alveoli, but less so in the larger air passages than that found in 1. The larger passages were densely filled with carbon, usually when contiguous to dense infiltrated areas.

3. Sections taken from the lung one hour after nasal instillation in the vertical posture without anesthetic revealed findings similar to 1 and 2, except that there were no free masses of carbon in the larger air passages, it being found mainly in the finer pulmonary divisions and alveoli.

4. Sections taken from the lung 13 days after nasal instillation in the vertical posture, without anesthetic, revealed the carbon deposit still present in mass form in the alveoli, with many carbon pigment phagocytic cells around the carbon. Pigment cells were also present in the alveolar walls and in the perivascular lymphoid tissues. The major part of the carbon masses, however, seemed still to be present without producing any interstitial changes except the exudation of the phagocytic cells into the alveoli.

5. Sections taken from the lungs 21 days after nasal instillation in the vertical posture, without anesthetic, revealed dense infiltrations of pigment-bearing cells into the walls of the larger air passages, into the perivascular lymphoid tissues, and alveolar walls. The major part of the carbon masses, however, still remained in the alveoli with many phagocytic cells amidst them. The larger air passages were comparatively free from carbon except for the presence of an occasional heavily carbon laden stippled phagocytic cell.

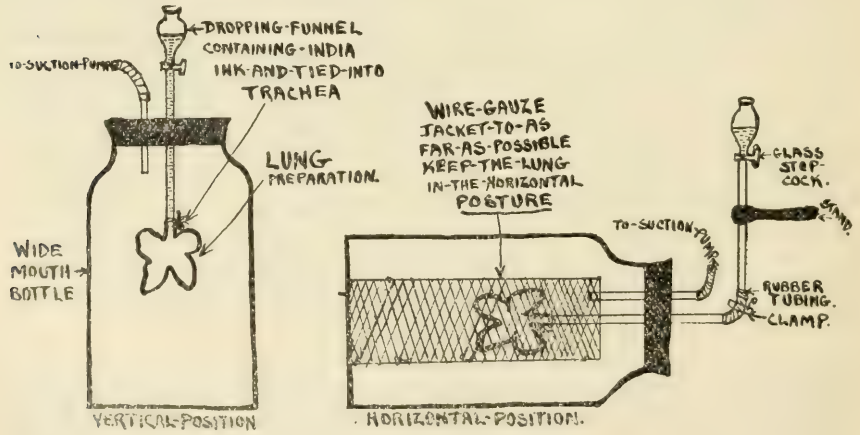
6. Sections taken from the lungs 6 1/2 weeks after nasal instillation in the vertical posture, without anesthetic, revealed very little change from the findings in 5. (21 days) although a great deal more carbon is found in the perivascular areas. Dense masses, however, are still found in the alveoli in certain locations.

7. Sections taken from the lungs 12 weeks after nasal instillation in the vertical posture, without anesthetic, revealed very little change in findings, in so far as the histologic picture was concerned, from that seen in the lungs after 6 1/2 weeks. A great deal of the massive carbon deposits in the alveoli were still present while pigment bearing cells were found in the alveoli, alveolar walls and perivascular areas. The latter being densely

loaded with pigment cells in places. The larger air passages are comparatively free from pigment-bearing cells.*

The microscopic findings in the lungs after the inspiration or aspiration of fluids from the upper respiratory tracts following nasal instillation in rabbits, would seem to indicate that fluids containing particulate matter (india ink) quickly tend to attain the finer divisions of the lungs—the alveoli—, the particulate matter to be retained there for a comparatively long time,, over 15 weeks, while in the gradual process of removal by phagocytic cells. The entrance of liquid to the finer air sacs is rapid and occurs early, in distinction to inhaled particles suspended in the air as smoke which gradually tend to accumulate in certain sites of predilection in the larger air passages, and only after prolonged inhalation reach the alveoli and then in comparatively small amounts. Regarding the ultimate final disposition of both forms—the inhaled smoke and the suspended particles in liquid—all that can be said is that they probably both enter the same interstitial and glandular abodes. It seems also that smoke or soot reaching only the larger air passages has a far greater opportunity to be expelled without entering the tissues, either within or without phagocytic cells, than the same form of particulate matter or carbon in liquid suspension entering the alveoli.

The immediate distribution in the lungs of india ink following nasal instillation, made it seem highly probable that the guiding forces in determining the postural localization were probably mainly two—gravity and inspiratory suction resulting from respiration. If this were true it should be possible to imitate the postural localization by means of an *in vitro* experiment. For this purpose a large wide mouth bottle of about 2 liters capacity was fitted with a two-hole rubber stopper.



* Subsequent further gross and microscopic studies on the remaining rabbits of this series will be reported later to complete this part of the study.

Through one hole of the stopper was passed a glass tube to be connected at the external end by means of rubber tubing to a small separatory funnel with glass cock and to contain the liquid—india ink—to be aspirated into the trachea of a rabbit's lung tied to the internal end of the glass tube and hanging within the bottle. Through the second hole in the rubber stopper is passed another glass tube connected with a suction pump by means of rubber tubing, with a suitable clamp to open or close this opening. The purpose of the latter connection to the suction pump is to produce a suitable negative pressure to imitate that obtained during inspiration in the pleural cavity. In order to place the lungs in the horizontal position in this bottle apparatus, a wire gauze jacket around the lung was prepared, to prevent sagging of the lungs during this posture of the bottle.* (See diagram of apparatus). With this apparatus it was possible to duplicate the *in vivo* postural experiments with india ink.

1. With the lung suspended in the vertical posture a few cubic centimeter of india ink were permitted to enter the trachea by causing the lungs to expand with slight negative pressure. The india ink entered the lungs uniformly on both sides, slightly more in the lower portions of the lower lobes than the upper.

2. A few cubic centimeters of india ink were permitted to enter the trachea with the bottle lying on its side, the left lung lowermost. The india ink was entirely found in the left lung, having entered the upper lobe first, and finally the lower lobe completely blackening it.

3. In this experiment, a duplicate of 2, a smaller amount of india ink (about 0.5 cc.) was allowed to run into the trachea while the left lung was lowermost. The india ink entered the upper lobe mainly, with a small amount only entering the upper portion of the lower lobe of the left lung.

DISCUSSION

Although a great deal of information has been obtained from these studies relative to the inhalation of finely suspended particulate matter in air and the inspiration or aspiration of like matter suspended in fluids, the application of this information to intrapulmonary therapy, especially in tuberculosis, would at present lead to conclusions of its negative value for several reasons, its irregular localization and the inability to place it where most desired, except within crude limitations. It is to be hoped, however, that observations along this line be encouraged for in spite of the apparent completeness of this study there are many unanswered discrepancies, i. e. Why are certain miliary tubercles in the lungs after inhalation of carbon (smoke) so well and efficiently surrounded with a layer of carbon pigment-bearing cells while others are apparently free from such envelope? If under proper conditions these pigment-bearing

* Dr. O. S. Kretschmer kindly aided with the perfection and use of this apparatus for which we are duly grateful.

cells, carrying appropriate substances, may be made to surround the diseased focus and thus form a barrier to the further progress of the tubercle bacillus, there may still be hope in the efficient application of this method. It is only too well known that coal miners are not as susceptible to phthisis as workers in other dusty trades; whether this is due to the lymphatic stasis and fibrosis produced by the coal or carbon as maintained by Klotz, or whether certain inherent antiseptic properties of the carbon, as has been demonstrated experimentally,[18] may be the important and decisive factor, or whether a combination action accounts for it has not been definitely established. Mavrogordata[19] has shown that there is a decided difference in the cellular response to various dusts in the lungs. It seems important also to consider in subsequent researches, especially if exact localization of inspired liquids becomes feasible, whether this mode of application of a barrier around the tubercle bacilli would be more efficient than by the inhalation method.

Regarding the migration of the carbon pigment-bearing phagocyte it may be questioned whether this cell can only enter the tissues through the alveolar walls, its marked migratory power as seen in the vicinity of the tubercles would bespeak greater and more diversified mobile power throughout the lungs than this. Is it to be inferred that these cells can carry pathogens (tubercle bacilli) into the tissues only through the alveolar walls and above this point in the lungs entrance is barred, the phagocytic cell and its burden to be eventually expelled by the way of the upper air passages? Although it may be admitted that a large amount of dust, smoke, and particulate matter inhaled, eventually reaches the pharynx and is swallowed or may be expelled, can it be inferred that the same fate awaits such material ingulfed by uninjured phagocytes in the majority of cases?

Although under certain circumstances there is easy access for fluids from the upper to the lower respiratory tract, as for instance in an animal like the rabbit accustomed to the horizontal posture but placed in the upright position, there must be a more efficient protection normally for those naturally living in the upright posture or it would seem that respiratory infection as a result of upper respiratory tract contamination would exterminate or abolish the upright type. Under anesthesia, however, the ready access of fluid to the lungs from the upper respiratory tract in the horizontal posture should serve as a warning that, as far as possible, by proper consideration for gravity conditions, such postures should be avoided during anesthesia as would tend to facilitate the easy access of fluids from the upper to the lower respiratory tract.

SUMMARY

The immediate intrapulmonary localization of particulate matter inhaled as smoke (carbon suspended in air) differs from that of the same material inspired or aspirated in fluid suspension. While the former localizes early, mainly in the larger air passages of the respiratory tract and

in certain definite localities, on histologic projections at the bifurcations of the air passages, and only after prolongd inhalation deposits in the smallest respiratory divisions—the alveoli—and then only in comparatively small amount, the latter—liquids—have a tendency to be aspirated immediately into the finest pulmonary divisions where the greater part of the particulate matter is retained for a relatively long time (longer than 15 weeks in rabbits).

Inspired or aspirated fluid suspensions of particulate matter (india ink) localize in the lungs of animals dependent upon the posture in which the animal was held during the entrance of the fluid into the lungs. In the horizontal posture during ether anesthesia in rabbits and dogs, india ink following nasal instillation with the head slightly elevated is found mainly in the upper lobe of the right or left lung depending upon whether the animal was lying on the right or left side, respectively, during instillation. Normally in the horizontal posture without anesthetic, fluids do not readily enter the lungs, although in the upright (vertical) posture with the head slightly extended, the fluid readily enters the lungs of these animals, normally accustomed to the horizontal posture, rather more easily in the rabbit than the dog, and tends to localize mainly in the lower lobes of the lungs. These observations strongly favor the idea that the localization of aspirated fluids in the lungs is largely determined by physical forces—gravity and inspiratory suction. This is borne out by the *in vitro* imitation of the postural results obtained *in vivo*. Miliary tubercles in rabbit's lungs tend, after prolonged inhalation of air containing suspended carbon, as smoke, to become surrounded by a ring of carbon which may be complete or merely as an eccentric deposit. The deposit, being practically entirely intracellular, consists of carbon laden phagocytic cells, which apparently have wandered to the site of the tubercle from neighboring areas. Many tubercles, however, are free from such surrounding deposits, a fact which is unexplained in view of the universal presence of the carbon in the lungs when inhaled, but which nevertheless depreciates the effective use of this method as a possible therapeutic procedure.

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PULMONARY TUBERCULOSIS EXPERIMENTALLY PRODUCED BY ASPIRATION *

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Progress in the study of many phases of pulmonary tuberculosis has been retarded because it has been impossible in the past satisfactorily to produce phthisis with all its manifestations as to tissue changes and localization in the experimental animal. Many of these studies have, therefore, been confined to man, and, to say the least, they were often discouraging and of rather limited value, being in many cases restricted to the terminal case that could subsequently be sectioned. It has been rather unsatisfactory to the investigator to be confronted with the statement that observations on pulmonary tuberculosis in animals could not be applied to man without definite reservations because the disease in the two cases presented certain distinct irreconcilable clinical and morphological differences. The roentgen ray picture in spite of its extreme value in elucidating many phases of pulmonary pathology did not quite fulfill the early expectations, and, although much has been learned regarding the gross morphologic and anatomic changes resulting from the tuberculous disease process in the lungs as may be seen from the numerous valuable reports (Dunham,[1] Amberson,[2] and others), the graded finer tissue changes and the stages of consecutive progress of the disease in the lungs still require more detailed study, with better and more refined methods. Bissell[3] in 1916 in commenting on the pathognomic roentgen signs of pulmonary tuberculosis states, "unfortunately, it is impossible at will to reproduce this disease in animals. We are thus compelled to rely entirely upon the study of human tuberculosis in the hospital and dispensary patient or after autopsy."

It is true much has been learned from postmortem studies in man but the multiple views (Ghon, Virchow, Tendeloo, Ziegler, Birch-Hirschfeld and others) on so apparently simple a question as the primary seat of the tuberculous focus in the lungs should lead us to believe that either our methods are too crude or the possibilities may include any of the expressed views. The universality of tuberculosis, however, and the possibility at any age of primary infection which may heal or progress make it seem far more important practically that it be determined how to prevent spread of the disease in the lungs, what to expect after

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pulmonary dissemination has occurred, and in how far therapy can prevent destruction and remedy it after its establishment. Herein lies the value of a duplication in animals of the type of pulmonary tuberculosis found in man. There are certain characteristics of pulmonary tuberculosis in man which have been impossible of consistent duplication thus far in animals. Probably the most important of these is the apical localization for which there are many interesting explanations including Freund's theory of stenosis of the upper thoracic aperture, advanced about sixty years ago and given support by Bacmeister's experiments reported in 1913.[4] Many observers, however, are inclined to view the deformity of the thoracic girdle as a result rather than a cause of tuberculosis. Another interesting explanation for the pulmonary localization is given in the studies by White and Gammon[5] who found that Sudan III in oil injected intravenously into rabbits was retained entirely in the pulmonary circulation and had a favored localization in the lungs which is likened to that of tubercle bacilli. Many other suggestions have appeared in the literature but none suffice to explain fully or duplicate with any exactitude the typical pulmonary distribution in man.

Many methods have been used for the direct intrapulmonary inoculation of tubercle bacilli in an attempt to simulate the human disease. Among these may be mentioned especially the exact and detailed study by Lewis and Montgomery[6] who appreciated the necessity of having at our command methods of reproducing as nearly as possible in experiment the conditions that prevail in chronic pulmonary tuberculosis. They utilized the technic of Lamar and Meltzer[7] for the intratracheal injection in dogs using a bovine bacillus (about 100 mgm.) from human source, virulent for guinea pigs, rabbits and cattle. At autopsy it was found that in all instances inoculation had been made chiefly into the right caudal lobe. In most instances there was a considerable diffuse consolidation of the right middle lobe and some focal involvement of other lobes, particularly the left caudal lobe. In the earlier cases, before the fourteenth day, whether the animal died or was killed the pneumonic areas were reddish grey. Later they were gray, yellow or white. In the later stages there was a tendency for the tissue to soften in spots, and in those cases examined between the seventeenth and the twenty-fourth days the softened matter had frequently been discharged through a bronchus, leaving a cavity. The cavities were variable in size and frequently were in the form of ramifying excavations containing exposed blood vessels. No hemorrhage from the cavities was noted and membranous walls were not observed. In animals examined more than three weeks after infection there was always a miliary tuberculosis of the unconsolidated portion of the lungs, the spleen, the kidneys, and especially of the liver. When cavities approached the pleural surface, the pleura was always definitely thickened. In no instance was there a definite pleural exudate. Microscopically at ten days the process was exudative in character, the alveoli containing fibrin, red blood corpuscles, polymorphonuclear leucocytes

and endothelial phagocytes (actively proliferating). At this time small groups of alveoli began to show necrosis and the bacilli in these localities were very numerous. From the fourteenth to the twentieth day necrosis and caseation became more extensive. The necrosis seemed to begin in the exudate and when it became marked the adjoining fixed tissues became involved. Cavity formation may occur when the fixed tissues are involved in the necrosis. Cavity formation occurred by a necrosis extending into the bronchus from the surrounding exudate. No instance of a primarily ulcerated bronchial mucosa was observed. On account of the variation in the process in different animals a division into periods could only be arbitrary since one animal dying at twenty-two days revealed a microscopic picture fitting the ten day interval. Lewis and Montgomery conclude that they have effectively reproduced an exudative type of tuberculosis of the lungs and that probably lobar pneumonias generally are of bronchogenic origin from the fact that a characteristic tuberculous pneumonia may be produced by the method of bronchial insufflation.

More recently Rogers[8] succeeded in producing a pulmonary tuberculosis in guinea pigs by allowing them to inhale finely divided droplets of positive sputum from man produced by means of an atomizer. The lesions were, however, distributed throughout both lungs and in all the lobes and were of varying sizes. The disease was not entirely restricted to the lungs alone being found in the liver and spleen. This method, as devised by Baldwin, for the purpose of studying the effect of dust inhalations upon tuberculosis was also used in guinea pigs by Gardner[9] and about the same findings obtained.

In 1920 Mullin and Ryder[10] reported on the production of pulmonary tuberculosis in rabbits by the inhalation of suspensions of tubercle bacilli from the nose.

"The technique was simple as possible. The rabbit was held, usually on its back, with the nose elevated, and 1 cc. of bacterial emulsion allowed to flow into one nostril from a pipette inserted just far enough to insure the fluid entering the nose."

Only two rabbits were thus far treated with tubercle bacilli but the findings warrant full consideration.

"Rabbit 5. Given 0.5 cc. of an emulsion of human tubercle bacilli in the nose (amount of bacilli not recorded). It was autopsied 7 weeks later, when it showed no lesions of the respiratory mucous membranes above the lungs. The lungs showed advanced tuberculosis of the right upper and middle lobes with consolidation, and moderately advanced tuberculosis of the bronchial nodes. The cervical nodes, spleen and mesenteric nodes, were all negative both grossly and microscopically. Rabbit 6. Given 0.75 cc. emulsion and killed after seven weeks. The autopsy findings, gross and microscopic, were identical with Rabbit 5, the tuberculous process being limited to massive infiltration of the upper and middle lobes of the right lung, and moderately advanced lesions of the bronchial nodes."

Though the experiments on tuberculosis by Mullin and Ryder were few, coupled with their findings on the inhalation of India ink, they seemed to blaze the trail for important possibilities and warrant further and more elaborate investigation along these lines.

In a study just published by Corper and Robin[11 12] it was found that the immediate intrapulmonary localization of particulate matter inhaled suspended in air differs from that of the same material inspired or aspirated in fluid suspension. While the former localizes early, mainly in the larger air passages of the respiratory tract, the latter—liquids—have a tendency to be aspirated immediately into the finest pulmonary divisions where the greater part of the particulate matter is retained for a relatively long time. Inspired or aspirated fluid suspensions of particulate matter localize in the lungs of animals dependent upon the posture in which the animal was held during the entrance of the fluid into the lungs. In the horizontal posture during ether anesthesia in rabbits and dogs, india ink following nasal instillation with the head slightly elevated is found mainly in the upper lobe of the right or left lung depending upon whether the animal was lying on the right or left side, respectively, during instillation. Normally in the horizontal posture without anesthetic, fluids do not readily enter the lungs. But in the upright (vertical) posture with the head slightly extended, the fluid readily enters the lungs of these animals, normally accustomed to the horizontal posture—rather more easily in the rabbit than the dog—and tend to localize mainly in the lower lobes of the lungs. They conclude that these observations strongly favor the idea that the localization of aspirated fluids in the lungs is largely determined by physical forces—gravity and inspiratory suction, and for the purpose of testing this imitate the postural results by *in vitro* experiments. In view of the fact that posture so largely determined the intrapulmonary distribution of inspired or aspirated fluids, and that in the case of animals under ether anesthesia in the horizontal posture and lying on either the right or left side, the particulate matter tended to an upper lobe (in the sense of human pulmonary anatomy) distribution, it seemed highly probable that this method could be utilized for producing a pulmonary tuberculosis in dogs which would resemble at least in so far as distribution was concerned that seen in man. To obtain then the variegated picture, analogy to tuberculosis in other parts of the body would indicate that it was merely a matter of dosage and virulence of bacilli—either leading to a progressive destructive pneumonic picture with high virulence or many bacilli, or a chronic, fibrotic, healing type with few or low virulence bacilli. It is well known, although not accepted by all, that the majority of the tissue changes of tuberculosis, even to the point of the formation of ulcers, can readily be reproduced by using dead tubercle bacilli—provided the amounts are properly adjusted. The lung being apparently a favorable site for the easy discharge of such necrotic material it seems reasonable that the formation of intrapulmonary tuberculous cavities by

using dead bacilli may be reasonably expected. The use of dead bacilli in studies as contemplated would also possess the advantage that they can be handled in large amounts without danger. A further advantage is that a complete picture of the effect of a single tissue insult by the bacilli upon the lungs could be obtained, uncomplicated by such influences as a repetition of those insults through the growth of the bacilli in the lungs and other parts of the body, a complication such as occurred in the studies by Lewis and Montgomery where the pictures obtained for this reason were variegated.

In all the experiments to be reported in this study dead human and bovine tubercle bacilli were used which had been grown in large amounts on glycerol broth for the preparation of tuberculin and had been heated to 100° Centigrade several times to insure death of all the tubercle bacilli. They were then washed carefully with about three to five changes of sterile physiologic saline solution to remove all non-bacillary debris and soluble substances. A volumetric dilution of one part of bacilli to five parts of saline solution was then utilized for nasal instillation, being well shaken each time before use. Dogs only were used in these studies on account of their natural resistance in Denver to respiratory affections, rabbits being highly susceptible to snuffles and therefore less suited for uncomplicated studies of the type in contemplation.

All the dogs were anesthetized (ether being used) and while lying on either the right or left side with the head slightly elevated the desired suspension of bacilli was dropped into one of the nostrils when it was promptly sucked into the nasopharynx. In previous experiments it was found that the intrapulmonary distribution of india ink was in no wise influenced by the nostril, right or left, into which the fluid was dropped. The dogs were usually kept lying on the side desired for about ten or fifteen minutes after nasal instillation to insure the postural distribution of the fluid.

THE POSTURAL DISTRIBUTION OF PULMONARY TUBERCULOSIS FOLLOWING NASAL INSTILLATION OF DEAD HUMAN AND BOVINE BACILLI IN DOGS

Nine dogs were included in this part of the study; three of them receiving suspensions of dead human bacilli in saline, three suspensions of dead bovine bacilli in saline and three a mixture of dead human bacilli in suspension of india ink in saline (1:1).

Dog 1. Received a nasal instillation of about ten cc. of the suspension of dead human tubercle bacilli while under ether anesthesia with head elevated and lying on the right side. Postmortem twenty-three days later revealed a massive tuberculous involvement in the right upper lobe with dense fibrous pleural adhesions between the visceral and parietal pleura in the region of the third and fourth ribs laterally. The rest of the lung was free from tuberculosis macroscopically.

Dog 2. A duplicate of Dog 1. received about ten cc. of the suspension of dead human tubercle bacilli in the nose while lying on the left side. Postmortem twenty-three days later revealed massive tuberculous involvement of the left upper lobe and the upper part of the left lower lobe. There was a slight involvement of the right upper and middle lobes. Histologically in the involved areas there is a massive consolidation and cellular infiltration in which all semblance of lung tissue is lacking, areas rich in cells with deep staining nuclei and cytoplasm are interspersed with areas of apparent intact cell paucity, the cytoplasm staining pale and being dotted with nuclear remnants. Throughout the involved areas the bronchi and bronchioles are wrinkled and compressed as though from external pressure but the cells lining the walls seem highly resistant to the destructive changes going on even in the necrotic areas. In the lesser involved areas the alveoli are found free from cells but for a distance from the actual foci of consolidation the alveolar walls are markedly thickened and infiltrated—an interstitial pneumonitis. The blood vessels and capillaries in and around the consolidated areas are congested. Occasional carbon pigment deposits irregularly distributed are found in the consolidated areas. The predominating cell in the infiltrated areas is the large endothelial leucocyte with large pale but distinct staining nucleus and cytoplasm. All types and forms of this cell are seen. Polymorphonuclear leucocytes and a few small mononuclears cells are interspersed among these. In the necrotic areas the cells have become vacuolated and the nuclei and cytoplasm stain faintly, many of the nuclei seem to be undergoing lysis and there are seen many transparent shadows of former cells.

Dog 3. A duplicate of Dog 1. Received the bacilli by nasal instillation while lying on the back. Postmortem twenty-three days later revealed no macroscopic tuberculosis.

Dog 4. Received a nasal instillation of about ten cc. of the suspension of dead bovine tubercle bacilli while under ether with head elevated and lying on the right side. Postmortem twenty-five days later revealed a massive tuberculous involvement of the lower portion of the upper lobe of the right lung and of the contiguous part of the middle and lower lobes. Presents a histological picture resembling to a great extent that seen in Dog 2 except that there is more peribronchial and perivascular carbon pigment deposit. In the vicinity of the consolidated granulation tissue areas are seen alveoli containing an albuminous fluid (edema) with many large endothelial phagocytes and polymorphonuclear leucocytes. The reaction in this lung seems to be more exudative in character especially around the consolidated areas, than in that from Dog 2. The consolidated areas, however, resemble those of Dog 2 and consist of a typical young granulation tissue with predominately endothelial leucocytes and a few polymorphonuclear leucocytes; the deeper staining being interspersed with more or less necrotic areas with pale staining cells and nuclei.

Dog 5. A duplicate of Dog 4 received the dead bovine bacilli while lying on the left side. Postmortem twenty-five days later revealed the tuberculosis as a massive involvement in the upper lobe of the left lung. There were a few scattered foci in the right lung macroscopically. A dense adhesion exists on the mesial surface of the upper portion of the upper lobe of the left lung. Histologically the lungs resemble Dog 4, with a predominance of the necrotic areas and the presence of a slight amount of pulmonary edema and exudative intraalveolar infiltration.

Dog 6. A duplicate of Dog 4. Received the dead bovine bacilli by nasal instil-

lation while lying on the back. Postmortem two weeks later revealed the tuberculosis in the anterior portion of the upper lobe of the right lung and in the lower lobe of the left lung as multiple discrete foci.

Dog 7. Received a nasal instillation of about ten to fifteen cc. of a mixture of equal parts of dead human tubercle bacilli (1:5) and india ink while under ether with the head elevated and lying on the right side. Postmortem thirty-eight days later revealed the ink and localized tuberculosis in the lower part of the upper lobe and upper part of the middle lobe of the right lung with connecting adhesions between the two lobes at the site of involvement. Histologically the lungs resemble those from Dog 2, with massive granulation tissue areas with rich staining nuclei and cytoplasm interspersed with areas of paler staining cells—necrotic areas. The proliferative intraalveolar reaction and edema was absent from this lung, the reaction being more of an interstitial proliferative pneumonitis. It was rather interesting that the carbon deposits, being at this time mostly intracellular, were confined mainly to the center of the massive tuberculous areas.

Dog 8. A duplicate of Dog 7 received the mixture of dead human bacilli in the nose while under ether lying on the left side. Postmortem thirty-six days later revealed the ink and tuberculosis as multiple small nodules in the upper lobe and upper portion of the lower lobe of the left lung.

Dog 9. A duplicate of Dog 7. Received the dead human bacilli and india ink while under ether lying on the back. Postmortem twenty-one days later revealed the ink and tuberculosis posteriorly in the upper, middle, and lower lobe of the right lung with dense interlobar adhesions in the involved regions and in the upper part of the lower lobe of the left lung as localized tubercles.

This series seems to indicate that pulmonary tuberculosis with many of its characteristics including granulation tissue infiltration and subsequent necrosis of the newly formed lung parenchyma, fibrous interlobar and pleural adhesions, and apical localization can be reproduced in dogs given nasal instillations of dead human or bovine tubercle bacilli with the head slightly elevated and kept lying on the side on which the involvement is desired. Unfortunately, however, even though the prerequisite, necrosis, for cavity formation was seen histologically the time interval of study apparently was too short and further observation seemed highly desirable.

THE CONSECUTIVE PULMONARY TISSUE CHANGES PRODUCED BY ASPIRATED DEAD TUBERCLE BACILLI FOLLOWING NASAL INSTILLATION DURING ETHER ANESTHESIA IN DOGS

In order to follow consecutively the pulmonary tissue changes produced in the course of time by dead tubercle bacilli aspirated into the lungs after nasal instillation in dogs under ether anesthesia, twelve dogs were anesthetized and while lying on the right side with head slightly elevated were given nasal instillations of about ten to twenty cc. of a one to five suspension of washed dead human tubercle bacilli in sterile saline solution. The dogs were then sectioned at intervals and the lungs examined macroscopically and microscopically.

Dog A. Received a nasal instillation of about ten cc. of the suspension of dead human tubercle bacilli while under ether with head slightly elevated and lying on the right side. Postmortem examination eleven days later revealed no appreciable macroscopic tuberculosis in the lungs.

Dog B. A duplicate of Dog A, died nine days after nasal instillation and revealed a marked hemorrhagic pneumonia of the entire right lung macroscopically.

Dog C. Was examined fourteen days after nasal instillation of dead human tubercle bacilli during ether anesthesia and lying on the right side. The lungs revealed macroscopically a spontaneous-anthracosis throughout all the lobes of both lungs and a massive tuberculosis of the upper lobe of the right lung, which appeared as multiple large nodules on the external and internal (mesial) aspects of this lung. No appreciable tuberculosis was found in the rest of the lung. Microscopically there was carbon pigment, usually intracellular, distributed uniformly throughout the pulmonary tissues regardless of whether tuberculous or not, differing thus distinctly from that seen in Dog 7, in which india ink and tubercle bacilli were injected coincidently and the carbon was found mainly in the center of the involved areas. Histologically there are found areas of massive consolidation and cellular infiltration in which all vestiges of former lung tissue are absent and only the larger bronchioles and bronchi persist with wrinkling of their walls due to external compression (resembling in appearance intestinal villi) and perfect preservation of their columnar epithelium. Interspersed in the rich cellular areas are fields of necrosis with sparse nuclear and cellular content. In the lesser involved areas the infiltration is entirely interstitial resulting in a marked thickening of the alveolar walls. The blood vessels and capillaries in and around the involved areas stand out distinctly and appear congested. There is no visible hemorrhage but a large amount of anthracotic pigment which is distributed in the perivascular and peribronchial tissues of the involved and non-involved tissues thus differing from the carbon found in Rabbit 7, resulting from the india ink introduced with the bacilli. The predominating cells in the infiltrated areas were the endothelial phagocyte (epithelioid cell) and polymorphonuclear leucocytes with a few small round cells interspersed.

Dog D. Was examined twenty-five days after nasal instillation of dead human tubercle bacilli under ether and lying on the right side. The lungs revealed macroscopically a massive involvement of the anterior and middle portions of the upper lobe and the anterior upper border, with a few discrete spots throughout, of the middle lobe of the right lung. The rest of the lung was negative macroscopically. Histologically the tissues resemble the lung findings in Dog C in every detail.

Dog E. Was examined forty-one days after nasal instillation of dead human tubercle bacilli under ether and lying on the right side. The lungs revealed macroscopically extensive tuberculous involvement of the upper and middle lobes of the right lung, the rest being negative, and there was a distinct fibrous adhesion on the external anterior apical surface of the upper lobe of the right lung. Necrosis seems to be prominent macroscopically. Microscopically the lung mainly resembles the pulmonary findings in Dog C and D but in addition there are found areas of distinct interstitial pulmonary hemorrhage bordering the markedly infiltrated areas and especially in the alveolar walls that are thickened. In places masses of red corpuscles may also be seen sparsely scattered in the alveoli and smaller air passages.

Dog F. Was examined fifty-six days after nasal instillation of dead human tubercle bacilli under ether and lying on the right side. The lungs contained

macroscopically a massive involvement of the entire lower and middle portion of the upper lobe and posteriorly there were a few foci in the middle lobe of the right lung. The gross appearance of the lesions resembled those of the lungs of Dog E. Microscopically the pulmonary findings resemble those in the lungs of Dog E, except that tissue necrosis in the consolidated areas seems to be more marked, even affecting the smaller consolidated areas. The general impression gained from study of the histologic sections seems to convey the idea that this is a more advanced process, not from the standpoint of healing, but rather from the standpoint of final tissue destruction (necrosis) than seen in the lungs of the previous dogs.

Dog G. Died one hundred and ten days after nasal instillation of dead human tubercle bacilli while under ether and lying on the right side. The lungs contained macroscopically a few large discrete tuberculous nodules in the lower and middle portion of the right upper lobe. No histologic study was made of this lung.

Dog H. Was examined one hundred and ten days after nasal instillation of dead human tubercle bacilli while under ether and lying on the right side. The lungs contained macroscopically many large tuberculous nodules in the upper and middle anterior and lateral portions of the upper lobe and a few discrete nodules in the upper middle portion of the middle lobe of the right lung. The gross and microscopic appearance of the lesions resembled those in the lungs of Dog F.

Dog J. Was examined one hundred and thirty-nine days after the nasal instillation of dead human tubercle bacilli while under ether and lying on the right side. The lungs superficially revealed massive tuberculous involvement of the lower portion of the upper lobe and the posterior upper border of the lower lobe of the right lung with a few nodules in the middle lobe and the lower and middle portion of the upper lobe and upper portion of the lower lobe of the left lung. On cutting through the massively involved areas there were found multiple various sized cavities many in communication, and some separated by very thin tissue walls. In many of these cavities were seen tissue strands and bare blood vessels passing across from one wall to another. The walls were lined by what appeared to be a granulation tissue and necrotic membrane. Microscopic examination of tissue taken from the cavity areas revealed numerous small cavities of different sizes, many having no definite walls but in many cases they seemed to be limited by the walls of a smaller or larger bronchiole which had been previously compressed by the tuberculous tissue and into which the necrotic material has ruptured and discharged. There is much interstitial hemorrhage, and blood is mixed to a great extent with the necrotic tissue being discharged; cross sections of the larger bronchioles contain large amounts of the blood and cellular mixture. The blood vessels in the breaking down tissues are distinctly congested and an occasional vessel is found in the center of the cavity and only attached to the wall by a flimsy projection of necrotic tissue. In some places distinct rupture of the necrotic material into a smaller bronchus can be followed out.

Three dogs still remain alive in this series and will be reported on in brief in a subsequent communication. This series of experiments seem to indicate that all the destructive and proliferative tissue changes produced by the tubercle bacillus in the lungs of man can be reproduced in dogs by using dead tubercle bacilli. The upper lobe localization of tuberculosis can be reproduced by dropping the suspension of bacilli

into the nose with the head slightly elevated during ether anesthesia and while the dog is lying on either the right or left side during and for a short time after such instillation.

DISCUSSION

The fact that the pulmonary tuberculosis as found in man has been reproduced in experimental animals will help solve many of the much disputed questions which have arisen in conjunction with studies in pulmonary tuberculosis and especially on the efficacy of the various therapies at present in vogue. No doubt many questions can be added to the few which will immediately enter one's mind as for instance the effect of artificial pneumothorax upon the inevitable cavity.

It seems from this study that if tissue insult, probably by numbers of bacilli introduced, is sufficient in the lungs, it is only a question of time before such destroyed or necrotic tissue will be discharged probably through a bronchus—apparently the road of least resistance—to leave the cavity as its ultimate result. Discharge through a bronchus rather than into the pleural spaces would seem to be the route of preference for the diseased tissue since in no case was a rupture into the pleura seen in these studies although more prolonged observations may still modify this view. The *restitutio ad integram* in the lungs would seem to prefer the cavity as the ultimate result of massive pulmonary necrosis, especially that resulting from a proliferative type of chronic disease like tuberculosis, rather than some other form i. e. encapsulation. May not this be an attempt to reform the spongy consistency of the lung?

Another important point brought out by this study especially as a result of the use of dead bacilli is the fact that given a definite amount of tissue insult, as determined by a certain number of bacilli used, the subsequent and final tissue destructive changes may not be finally determined in the lungs for a long period of time—it required about one hundred and thirty-nine days before cavities were found in the dogs. What is the subsequent fate of these cavities and when may the destructive process be expected to stop and retrogression set in? The value of this point alone for the elucidation of the disease in man is self evident. This apparently has never been definitely answered from previous studies with living bacilli in animals or from observations on man, although empirical surmises have been made. Even though capillary hemorrhage was not uncommon after a certain interval of time, it being present in practically all sections studied after forty-one days, profuse hemorrhage did not exist even when cavities were being rapidly formed.

SUMMARY

The upper lobe localization of pulmonary tuberculosis, the most common type of the disease found in man can be reproduced in dogs (in the sense of human postural anatomy) by the instillation of suspensions of

tubercle bacilli into the nose while the animal is lying in the horizontal posture (on the right or left side dependent upon the side on which involvement is desired) during ether anesthesia with the head slightly elevated. These experiments with tubercle bacilli verify the postural studies previously reported in animals in which india ink was used.

Dead human tubercle bacilli aspirated into the lungs of dogs during ether anesthesia while in the horizontal posture following nasal instillation reproduce in so far as pathologic pulmonary changes are concerned all of the important characteristics of the disease in man, except progression in the true sense of the term such as would naturally be dependent upon actual multiplication of the bacilli in the lungs. The most important of these changes including massive tuberculous granulation tissue formation with subsequent necrosis followed by discharge into the bronchi and resulting cavity formation, fibrous pleural adhesions and intrapulmonary capillary hemorrhages are all obtained and in a definite time sequence indicating that the full tissue insult initiated when the bacilli enter the lungs is not exhausted for a considerable period of time—visible cavities were found only after one hundred and thirty-nine days, while intrapulmonary capillary hemorrhage was seen regularly earlier (after forty-one days).

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THE PRESERVATION OF CULTURES OF HUMAN AND BOVINE TUBERCLE BACILLI *

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In the handling of large numbers of different cultures of tubercle bacilli for the purpose of perpetuating the individual strains it is important that the cultures be transplanted at a time when they are still viable, and when once fully grown that they be kept under conditions favorable to preserving the viability for the longest possible period consistent with the maximum time and labor conservation. These points are important, also, when it is considered that the average laboratory, if it carries along one or two strains of tubercle bacilli and uses these indefinitely, feels that its studies and conclusions drawn therefrom regarding the chemistry and biology of the tubercle bacillus are ample and applicable to all the different strains. This may, however, be far from the case and subsequent study may eventually reveal many individual types, as has been found in the case of pneumococci, within the larger groups of human, bovine and avian bacilli, not to mention those of lesser importance. It is true that even a few strains perpetuated over a long period of time in the incubator can occupy valuable space and thus tend to discourage growing more than the few necessary cultures, so that any method of preservation, once the culture has attained full growth, which will replace the incubator, will not only serve to conserve this valuable space but also will make it possible to continue many more different strains of bacilli keeping them always available for biological and chemical studies.

Little need be said regarding the incubator itself, since it is almost common knowledge that no lights of any kind should be permitted in this chamber during cultivation of tubercle bacilli, and the optimum temperature for human and bovine bacilli of about 37.5° Centigrade should be maintained at all times; besides a sufficient humidity should be supplied to prevent rapid drying of the cultures, which usually require from four to eight weeks to attain a good and probably maximum growth. The latter, however, varying to a great extent for the individual strains grown upon artificial mediums.[1] It is to be noted also that the tubercle bacillus grows readily within wide ranges of acidity of the medium; Long and Major[2] found no apparent inhibition in the growth of tubercle bacilli

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in a medium having a pH from 5.4 to 7.8 while Brooks,[3] in agreement found that changes in the H ion concentration from pH 4.4 to 7.4 produced no change in the rate of production of carbon dioxide by B. tuberculosis. Below 30° Centigrade human or bovine tubercle bacilli are not able to grow but may remain viable for long periods of time under proper conditions.

In considering the viability of the tubercle bacillus, however, there are two facts which merit mention, as has been pointed out by Theobald Smith,[4] a culture may still contain sufficient viable bacilli to infect a highly susceptible animal like the guinea pig when injected in large amounts after nineteen months and still will not grow on artificial mediums. It is common knowledge, and Smith also aptly points out this second fact, that even relatively young cultures on glycerol bouillon fail to grow when transferred to glycerol agar. The larger the mass of bacilli transferred, the greater the chance for successful subcultures, very fine suspensions failing to grow.

In summarizing the data reported by Smith which were collected from material used for studies in immunity and were therefore, not systematically performed, attention is called to a somewhat different behavior of the bovine and human strain used. In only one of the tests with the bovine bacillus did two of the subcultures fail to develop, while the human subcultures failed in all cases. This is attributed in part to the high acid reaction of the culture fluid at the end as compared with that of the bovine cultures. In considering the possible causes for the failure of living bacilli to multiply in subcultures the following suggestions are mentioned. (1) The change from glycerol bouillon to glycerol agar; (2) The partial injury of bacilli on artificial mediums so that the nutritive fluids of the guinea pig are required to bring the bacilli back to a normal condition; (3) The development of spores which cannot germinate on artificial mediums; (4) The production of a capsule which requires the action of animal tissues for its removal. The first is hardly tenable. The second possible explanation cannot be gainsaid, although it is somewhat contrary to current views. The third and fourth possibility are much alike. Smith favors the fourth interpretation since he has frequently seen what appear to be capsules around tubercle bacilli under cultivation. Certain bacilli in culture mediums may be conceived as dying slowly, another smaller group as ceasing to multiply and protecting themselves by some form of capsule against the increasing acidity and other unknown factors in the culture fluid.

In summarizing Smith states, "tubercle bacilli of both human and bovine type, when kept in fully developed cultures at 40° to 50° F., may remain infectious to guinea pigs for from seven to nineteen months. The number of bacilli surviving in such cultures is relatively small."

Kitasato[5] in cultivating tubercle bacilli from sputum observed that sputum or cavity material, though containing many tubercle bacilli which stained well, failed to grow. He believed such bacilli were dead

TABLE 1

Preservation of Full Grown Cultures of Tubercle Bacilli

Designation of Experiment			Cultural results on transplanting; interval in months of residence in incubator or icebox after full growth has been attained.								
Culture studied	Condition under which original was kept	Mediums used for transplant	2	4	6	8	10	12	14	16	18
"Human Avirulent"	Icebox	Petroff's	+++	++	0	0	0	0	0	0	0
		Glycerol agar	++++	+++	0	0	0	0	0	0	0
	Incubator	Petroff's	+++	++++	0	0	0	0	D**	D	D
		Glycerol agar	++++	++++	0	0	0	0	0	0	D
"Human Virulent 2463"	Icebox	Petroff's	++++	+++	++	++	C***	0	0	0	0
		Glycerol agar	++++	0	0	0	0	0	0	0	0
	Incubator	Petroff's	++	C	++	+++	+	0	D	D	D
		Glycerol agar	+++	+++	++	+	+	+	0	D	D

"Bovine Avirulent"	Icebox	Petroff's	++++	C	C	++++	++++	0	0	0	0
		Glycerol agar	++++	++++	0	+	+	0	0	0	0
	Incubator	Petroff's	++++	++++	++++	++++	+++	+	++	D	D
		Glycerol agar	++++	++++	++	++++	++	0	0	0	0
"Bovine Virulent"	Icebox	Petroff's	++++	++++	++++	0	C	0	0	0	0
		Glycerol agar	++++	++++	++	+	+	0	0	0	0
	Incubator	Petroff's	++++	++++	++++	++++	++++	+++	+++	+++	D
		Glycerol agar	++++	++++	0	0	0	0	0	0	0

*NOTE—The results given is the average reading obtained from 3 culture tubes in every case.
**NOTE—"D" indicates that the original full grown culture and medium kept in the incubator or ice-box had dried to such an extent that transplanting was not feasible.
***NOTE—"C" indicates that all the transplants became contaminated and no reading for growth of tubercle bacilli could be obtained.

and concluded that the majority of bacilli in sputum or other material from the lungs are dead and that this death cannot be recognized microscopically. Several guinea pigs inoculated with material which failed to grow were well when killed two months later.

Hesse[6] was able to grow bacilli on "Nährstoff Heyden" from all sputums positive microscopically and claims there are no dead bacilli in the sputum. Petroff[7] also claims very high percentage from positive microscopic sputums by a new method devised by him, but Corper, Fiala and Kallen[8] obtained only 27.3 per cent. positive cultures using this method with microscopic positive sputums.

Such claims, however, regarding the viability of tubercle bacilli in the sputum, in view of the difficulty in growing the bacilli on artificial mediums, cannot be taken seriously any more than the claims that all positive microscopic sputums will give positive cultures, and the solution of this problem awaits more delicate and accurate methods which will differentiate the live from the dead bacillus individually.

The purpose of the study to be reported in this contribution was to determine the most suitable mode of preserving over long periods of time fully grown cultures of human and bovine tubercle bacilli with the least detriment to their viability and capability of reproduction after transfer onto suitable laboratory mediums. All attempts to preserve absolutely the virulence of tubercle bacilli on artificial mediums have proven futile and in most instances the loss of virulence during artificial cultivation with the average culture of human or bovine tubercle bacilli is a matter of years and also depends upon the variations of the individual strain of bacilli. Some strains have been carried many years on artificial mediums without appreciable loss of virulence for guinea pigs, while others under apparently identical conditions and carried on the same medium will become avirulent within a few years. Thus far there is no authentic record of a strain of tubercle bacilli having been carried on artificial mediums sufficiently long to lose its virulence for experimental animals and having it restored again by animal passage. Since the absence of light is so essential to a good preservation of tubercle bacilli,[9] and since low temperatures, unless extreme (far below freezing), have very little effect upon the bacilli, it seems that the two most suitable and available light-proof containers are the incubator and the ice-box used in modern laboratories. In order to have representative members of the human and bovine types of tubercle bacilli, the viability of four strains of bacilli—"Human avirulent" a laboratory strain of about ten years artifiial cultivation, "Human virulent 2363" a virulent strain of human bacilli isolated from sputum about two years ago, "Bovine avirulent" a bovine strain of low virulence for rabbits isolated about seven years ago and "Bovine virulent" a bovine strain highly virulent for rabbits isolated about one year ago, —having attained a good growth on glycerol agar and Petroff's gentian violet egg mediums by sixty days incubation at 37.5° Centigrade, were studied. Fifty culture tubes with abundance of bacilli of each strain

practically covering the entire slant were thus obtained and one-half of them (25) were kept in the incubator and the other half placed in the ice-box where they remained throughout the experiments. One tube from each set and representing each strain of bacilli was removed every two months and transplanted on new culture medium, the subculture being incubated for two months and then read. All subcultures were seeded heavily to obviate the possibility of failing to obtain growth provided sufficient bacilli capable of growing on artificial mediums were still present. The results of this study are given in table 1.

The conclusions to be drawn from these studies are that whether kept in the ice-box or incubator, on Petroff's medium or glycerol agar, it seems desirable to make transplants from full grown cultures of human tubercle bacilli at intervals of four months; of bovine bacilli eight months. This agrees with Smith's findings that the bovine strain was more resistant than the human. The ice-box preservation possesses the advantage over the incubator in that the mediums do not dry out as rapidly—drying of the medium and bacilli going hand in hand with rapid loss of viability. The maximum time of preservation of any culture studied was sixteen months on Petroff's medium in the incubator for "Bovine virulent;" the more vigorous growers seem to remain viable longer than the less vigorous.

SUMMARY

Fully grown cultures of human tubercle bacilli may remain viable on Petroff's gentian violet medium or five per cent. glycerol agar whether kept in the ice-box or in the incubator for from about four to eight months, so that successful transplants can be obtained on these mediums up to this time. Bovine tubercle bacilli are more resistant on these mediums (agreeing with Theobald Smith's findings) and may remain viable in the sense of furnishing subcultures for from about eight to sixteen months (the latter in exceptional cases). Drying of the medium tends to shorten the period of viability, and the more vigorous and profuse growers seem to give successful transplants after longer intervals than the less vigorous.

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AN ATTEMPT TO DIFFERENTIATE HUMAN AND BOVINE TUBERCLE BACILLI BY MEANS OF THE ANAPHYLACTIC REACTION*

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To keep pace with the theories promulgated to express the various ideas on anaphylaxis and allergy especially as it applies to tuberculosis is an almost Herculean task. It seems far simpler without referring to theories and ideas merely to adhere to the facts which have been observed and in most cases corroborated.

The phenomena of acute protein anaphylaxis and the immediate local skin manifestation of this phenomenon, as also the characteristic local tuberculin skin reaction, are too well known to merit exhaustive explanation. Just where to place in this assembly of reactions, the changed tissue manifestation to a second injection of tubercle bacilli, first described by Robert Koch, is difficult to state. No one acquainted with these phenomena can doubt that it may belong in this category and may be an expression either of some of the individual phenomenon or their varied combinations or manifestations.

In defining and giving the limitations of the term "Anaphylaxis" Wells[1] states that at least the following criteria must be met.

"1. The observed toxicity of the injected material must depend upon the sensitization of the animal; i. e., the substance must not produce similar symptoms in non-sensitized animals; 2. The symptoms produced must be those characteristic of anaphylactic intoxication as observed in the usual reactions with typical soluble proteins, being therefore the same for all antigens with the same test animal, but differing characteristically with each species of animal; 3. It should be possible to demonstrate passive sensitization with the serum of sensitized animals; 4. It should be possible to demonstrate typical reactions in the virgin guinea pig uterus strip; 5. It should be possible to demonstrate amelioration or prevention of bronchial spasm in guinea pigs by proper use of atropin and epinephrin; 6. The possibility that the observed symptoms are caused by capillary thrombosis or embolism must be excluded; 7. After recovery from anaphylactic shock there should be exhibited a condition of desensitization under proper conditions."

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He differentiates the terms anaphylaxis and allergy by stating:

"Reactions produced by substances not coming within this class cannot properly be considered as true anaphylactic reactions unless they can be demonstrated to exhibit the same phenomena (as soluble protein antigens). The term allergy is broad enough to cover all those manifestations of altered reactivity and to indicate their relationship to one particular form of allergy, anaphylaxis."

Wells also justly points out that on account of the difficulty of differentiating "anaphylactoid" reactions produced by agar and numerous other substances given intravenously it is preferable to use the intraperitoneal route. He also calls attention to the fact that entire proteins are necessary to produce anaphylaxis and that much of the work with cleavage products and commercial "peptones" is worthless. True soluble toxins and tuberculin, despite the fact that they produce a certain type of hypersensitiveness, are not anaphylactogens in the strict sense. The demonstration that anaphylactic sensitization can be transferred to a normal animal by injection of blood or serum from a sensitized animal, has been generally accepted as establishing anaphylaxis as a typical antigen—antibody reaction.

Anaphylactic reactions have been produced in many species of mammals but only in the guinea pig, rabbit and dog has the process been thoroughly studied. The striking fact soon developed that in each species the phenomena were different, and always the same in that species without relation to what antigen was being used. Sensitized animals may be refractory to anaphylactic reactions not only because of saturation or exhaustion of the fixed antibodies, but because the presence of free antibodies in the circulating blood prevents the antigen from coming in contact with the intracellular antibodies, i. e. the condition of anti-anaphylaxis. There has been much confusion in the literature because of the careless use of the term "anti-anaphylaxis" to cover all refractory conditions. This term should logically be applied only to a resistance due to antibodies, using the term "desensitization" for the condition which it described. It is this form of antibody resistance true specific anti-anaphylaxis, which accounts for the failure to obtain anaphylactic shock in guinea pigs immunized to a foreign protein by repeated injections.

Another form of refractoriness, which is essentially a desensitization, may occur when a large sensitizing dose is given. Non-specific transitory reduction of the intensity of anaphylactic reactions may be produced by intravaneous injection of numerous substances shortly before giving the intoxicating dose. Limited to typical anaphylaxis with protein antigens the anaphylaxis reaction exhibits exactly the same degree of specificity as obtained with the complement fixation or preciptin reactions.

Coca[2] in presenting restrictive definitions of the terms in general use in the literature of hypersensitiveness and to classify the known phenomena of peculiar physiological reaction in accordance with these definitions states: "It may be that the term hypersensitiveness will always be

needed for use in a general sense applicable to conditions of non-specific, exaggerated or unusual reactivity on the part of a living organism. Such conditions are illustrated in the exaggerated sensitiveness to light of the eye in conjunctivitis." There are, however, two groups of the phenomena of peculiar, physiological reactivity, which on account of definite, constant features can be separated from the others etiologically and these, though themselves of different etiology (Etiology refers, here, to the origin of the underlying condition, not to the exacting agents, which are often identical in both groups,) can be associated under the heading "hypersensitiveness." These two groups have been designated with the familiar terms "Anaphylaxis" and "Allergy." From the determining features of these two groups has been drawn the following definition of true hypersensitiveness; namely a condition of specific or particular reactivity, with characteristic symptoms, to the administration of or contact with any substance in a quantity which to most of the individuals of the same species is innocuous.

By the terms of this definition the tuberculin reaction of Koch and the so-called toxin hypersensitiveness are excluded from the category of true hypersensitiveness, because, 1. The symptoms of the tuberculin reaction are the same in all animal species. 2. The symptoms of toxin hypersensitiveness are not different from those of the normal physiological effect of the agent.

The terms anaphylaxis and allergy are not synonyms but are mutually exclusive terms. Anaphylaxis is a state of true hypersensitiveness that is due to the presence in certain tissues of specific antibodies. The symptoms of anaphylaxis are caused by the meeting of these antibodies with the respective antigen in those tissues. Certain characteristics of allergy resemble those of anaphylaxis but in other respects the two conditions are diametrically dissimilar. In summarizing the difference Coca says: "Anaphylaxis is an experimental, or induced, non-heritable hypersensitiveness due to the presence of specific antibodies in certain tissues. Allergy is a natural inherited condition of hypersensitiveness, which affects only human beings and is not dependent in any way on immunological antibodies." Kolmer,[3] believes there are true anaphylactic skin reactions.

Baldwin[4] in 1910, showed that guinea pigs could not be made skin-sensitive by implantation of porous filter capsules or celloidin capsules containing tuberculo-protein or living tubercle bacilli. Skin sensitiveness could never be produced without actual infection with living organisms. Animals treated with tuberculo-protein, however, often showed reactions to intravenous inoculation of the homologous preparation which could be recognized as anaphylactic. In summarizing he says: "Tuberculous animals become sensitive to anaphylactic test, but not uniformly so. There is no absolute relation between the degree of sensitiveness and the stage of the disease." Injections of the tuberculo-protein may sensitize normal guinea pigs. Sensitized guinea pigs, however, do not react to the ordin-

ary tuberculin test, though some respond slightly to the intradermal test. This difference between anaphylactic sensitization and tuberculin reactivity need not be fundamental, as it is possibly due to another factor as yet undetermined. His experiments on passive anaphylaxis to tuberculo-protein were inconclusive. In 1911 Krause[5] noted that practically any parenteral route by which a sufficient quantity of tuberculo-protein can be introduced may be used in sensitizing an animal. Sensitization can be obtained with 0.05 milligrams of tuberculo-protein, the shortest incubation period was 6 days and the longest duration of the hypersensitive state 286 days. He was unable to produce passive hypersensitiveness with the serum of sensitized animals but believed it possible under proper conditions. In 1913 Austrian[6] was able to obtain all the manifestations of typical hypersensitiveness to protein in guinea pigs with aqueous extracts of tubercle bacilli, with albumose-free tuberculin and old tuberculin that has been freed from glycerol and made poor in salts. Intraperitoneal sensitization was used and the post orbital, cardiac or intravenous route for intoxication. The passive transference of this hypersensitiveness was also obtained. Krause[7] stated in 1917 that it is easily possible to sensitize guinea pigs to tuberculo-protein so that they will give typical systemic anaphylactic reactions but such sensitized animals do not show cutaneous hypersensitiveness to tuberculo-protein, nor are they protected against infection with the tubercle bacillus. Skin sensitiveness can only be obtained by producing an actual tuberculous infection somewhere in the animal and when this tissue reactivity has developed it is found that the animal has the power to produce acute inflammatory reactions about injected bacilli, whereby its resistance is enhanced.

White[8] testing the cold alcohol soluble and hot alcohol soluble, cold alcohol insoluble constituents of three lots of virulent tubercle bacilli, found them not to possess antigenic properties in amounts of 25 to 100 milligrams by the anaphylactic reaction. None of the preparations, when injected intravenously into guinea pigs previously sensitized with tuberculo-protein, produced any anaphylactic symptoms whatever. Zinsser[9] found in tuberculous animals that positive skin reactions were usually obtained within 9 or 10 days after inoculation, the earliest being between the 6th and 7th days. At this time the animals were never anaphylactic by the Dale uterus method previously applied successfully by Weil.[10] An animal inoculated subcutaneously with tubercle bacilli and tested 3 weeks after inoculation showed a powerful anaphylactic uterine reaction, as well as skin reaction, indicating

(1) That guinea pigs suffering from infection with tubercle bacilli may become both skin reactive and anaphylactic;

(2) That the skin reaction develops early and may exist without any detectable signs of general anaphylaxis as evidenced by the uterine reaction;

(3) That within 3 weeks or later, after the animals are still in fairly good condition, the skin reaction and the uterine reaction may coexist.

Zinsser says: "It is during this period that a simulated parallelism may have led others working with a less delicate anaphylactic method, into confusion. Toward the end when the guinea pigs are moribund, both the skin reaction and general anaphylaxis may fade, another feature which simulates parallelism."

Guinea pigs treated with extracts of tubercle bacilli do not develop delayed reactions of the tuberculin type and with very few exceptions it is entirely lacking in guinea pigs rendered anaphylactic by sensitization with tubercle bacillus products. Tuberculin hypersensitiveness is associated particularly, perhaps solely, with the existence of an infection.

Zinsser concludes: "Under the influence of contact with living tubercle bacilli, two distinct varieties of hypersensitiveness develop in guinea pigs One of them true anaphylactic hypersensitiveness, develops late and can be readily induced by appropriate treatment with dead bacterial materials, extracts, etc. The other the typical tuberculin reaction may be regarded as infection phenomena, for, while we may eventually succeed in inducing these reactions by modified methods of sensitization, they are most easily and characteristically elicited as soon as an infection is established, while, to date, they have but rarely and atypically followed upon any form of artificial sensitization."

In 1920 Fürth[11] reported on highly interesting experiments in which he was apparently able by means of the anaphylactic reaction in guinea pigs to differentiate different types of acid fast bacilli from each other for the purpose of determining the practical antigenic value of cold-blooded and other bacilli for vaccination purposes. Unfortunately he used the Ungermann and Selter's intravenous method. The authors of this method found that 100 to 150 milligrams of bacilli intravenously were satisfactory for the second injection and as small a dose as one milligram for the first injection would sensitize. Death usually occurred within 24 hours, or with typical anaphylactic symptoms in a few minutes in these studies. The strains tested by Fürth were a Vallee's strain, Friedman's turtle bacillus, grass bacilli and avian bacilli. The text of the paper is somewhat confusing regarding the actual experiments performed in addition to those given in a single detailed table. The table reports on a primary intraperitoneal injection of from 0.001 to 0.01 gram of Vallee's tubercle bacilli, 0.001 to 0.1 gram of avian bacilli, 0.001 to 0.1 gram of grass bacilli and 0.002 to 0.1 gram turtle bacilli, while the second injection 23 to 32 days later consisted of an intravenous injection of 0.05 gram of dead human bacilli, turtle, and grass bacilli, and an intraperitoneal injection of 0.5 gram tuberculin. O. T., a total of 29 guinea pigs being reported on. The conclusions drawn are that the grass and turtle bacilli were not antigenic for human bacilli, while the Vallee's and avian strains produced disease in the guinea pigs and were also antigenic. The data, however, is inconclusive for two reasons in that the second injection was given intravenously leading to possible anaphylactoid reactions and many of the animals were markedly tuber-

culous from the primary injection which may make an intravenous injection of any suspension produce fatal results.

Our studies reported in this contribution, are part of a more complete study having for its purpose the accumulation of facts regarding anaphylaxis, allergy, and the hypersensitive state in tuberculosis and its relation to the various biologic states of immunity. Since the literature so definitely points to the existence of a state of anaphylaxis produced with tubercle bacilli and their products, and since the former point has never been exhaustively determined, as well as the possibility of being able by this means to differentiate different strains of tubercle bacilli, these points were all kept in mind in planning the study, in order to determine whether the presence of tuberculosis or tubercle in the guinea pig bore any relation to the state of anaphylaxis. Since tubercle may be produced by either dead or living bacilli both types of bacilli were used. To obviate in any way the possibilities of "anaphylactoid" reactions, all primary inoculations of tubercle bacilli, alive or dead were made subcutaneously and all second or intoxicating injections were made intraperitoneally.

To cover the entire range of possibilities in using living bacilli the primary (sensitizing, infecting or tubercle forming) injection was given subcutaneously using three strains of human tubercle bacilli (Human,—an avirulent human strain and Gluckson and Galinsky, virulent human strains) of widely differing range of virulence for guinea pigs and two bovine strains (Bovine avirulent and Bovine virulent). The second or intoxicating injection was given intraperitoneally in wide range of doses 0.001 to 1.0 gram of the same bacilli, testing each strain against itself and all the others for possible strain specificity. The second injection was given 22 to 29 days after the primary. To determine the presence of non-specific reactions the various guinea pigs given primary injections of tubercle bacilli were also tested 29 days later by intraperitoneal injections of suspensions of living staphylococous Aureus in conformity with this experiment, in that living bacilli were used throughout. In the entire studies caution was exercised to prevent transferring antigenic substances by using only thoroughly cleaned syringes and only for one substance between the separate careful cleanings. All details and cautions exercised in any anaphylaxis studies were carefully observed throughout the entire studies. In using such a range of different cultures for the primary injection a wide range of tuberculosis was obtained. Postmortem examinations were made on every guinea pig 24 hours after testing for anaphylaxis so that this could be correlated with the anaphylactic findings to obviate the possible absence of reaction due to a moribund or advanced tuberculosis in the animal at the time of testing. Duplicate animals were also tested in each set to avoid possible difference due to individual characteristics. All the bacilli used were taken from young cultures not exceeding two months in age and actively growing at incubator temperature at the time. The bacilli were carefully and well ground up into a fine suspension for injection, to attain as far as pos-

TABLE I.

An Attempt to Produce Anaphylaxis with Living Tubercle Bacilli in Guinea Pigs.

Second Injection (22-29 days later) intraperitoneal		First or sensitizing injection subcutaneously in the groin																					
		Human 1 mg.				Gluckson 0.1 mg.				Galinsky 0.1 mg.				Bov. Vir. 0.1 mg.				Bov. Avir. 1.0 mg.				Controls			
Organism	Amount in grams	Result	tuberc	Result	tuberc	Result	tuberc	Result	tuberc	Result	tuberc	Result	tuberc	Result	tuberc	Result	tuberc	Result	tuberc	Result	tuberc	Result	tuberc	Result	tuberc
Human	1.0	2*	1**	2	?	D	3	D	3	D	3	3	4	D	3	D	3	D	4	D	4	3	–	3	–
	0.1	1	–	1	1	2	3	2	3	2	3	2	2	2	3	2	4	2	4	2	3	1	–	1	–
	0.01	0	–	0	–	1	3	1	2	1	2	0	3	1	3	0	4	2	3	1	4	0	–	0	–
	0.001	0	–	0	?	0	4	0	3	0	4	0	3	0	3			0	3	0	3				
Gluck-son	1.0	D	?	D	?	D	2	D	4	D	3	D	4	D	3	D	2	D	3	D	4	D	–	3	–
	0.1	1	?	2	1	3	2	2	3	2	4	2	2	2	3	3	3	D	3	2	2	2	–	2	–
	0.01	0	1	1	?	1	3	0	3	2	3	0	3	D	4	3	4	1	2	1	2	0	–	0	–
	0.001	0	–	0	?	0	3	0	2	1	3	0	4	1	3	1	4	0	4	0	3				
Galin-sky	1.0	3	?	D	?	D	3	3	2	D	3	D	3	D	4	D	4	D	4	3	3	D	–	3	–
	0.1	0	–	1	–	2	2	2	3	3	4	2	3	2	3	2	3	2	3	1	2	1	–	1	–
	0.01	0	?	0	–	0	3	0	4	2	3	1	2	0	4	1	4	0	3	1	3	0	–	0	–
	0.001	0	–	0	–	0	3	1	3	0	4	0	3	0	2	0	2								
Bov. Vir.	1.0	D	–	2	–	D	3	D	3	D	3	3	3	D	3	D	4	D	4	3	3	3	–	3	–
	0.1	1	?	1	–	2	3	2	2	2	3	2	3	2	4	2	2	D	3	2	3	1	–	0	–
	0.01	0	–	0	?	0	4	0	3	1	3	0	3	1	3	0	3	1	4	0	2	0	–	0	–
Bov. Avir.	1.0	D	?	3	–	3	3	3	3	D	4	D	4	D	4	2	3	D	3	1	3	D	–	2	–
	0.1	0	?	0	–	2	3	2	4	3	3	1	4	D	4	2	4	0	3	1	3	0	–	0	–
	0.01	0	–	0	?	0	3	1	4	1	3	1	4	0	4	1	4	0	3	0	2	0	–	0	–
	0.001	0	?	0	–	0	4	0	3	0	3	0	4	1	4	0	4	0	3	0	2				
Staph. Aur-eus live.	0.5	3	1	3	?	3	3	D	3	3	3	3	4	D	4	3	3	3	3	3	2	D 2 days	–	3	–
	0.05	0	?	1	–	0	3	1	3	1	4	2	3	1	3	1	4	0	4	1	3	0	–	0	–
	0.005	0	?	0	–	0	3	0	2	0	3	0	3	0	4	0	3	0	3	0	3	0	–	0	–

† In no case were acute anaphylactic symptoms seen — and all deaths recorded occured after 6 to 8 hours.

* 0 indicates animal is normal; 1 indicates animal is visibly ill; 2 indicates animal is very ill; 3 indicates animal is severely ill and may die; and D indicates animal died within 24 hours before all were sectioned to determine the amount of tuberculous involvement produced by the primary injection of living bacilli.

** — = no tuberculosis; ? = involvement of local glands only; 1 = enlarged local and retroperitoneal glands; 2 = enlarged local and retroperitoneal glands and slight involvement of spleen; 3 = enlarged local and retroperitoneal glands, spleen markedly involved, the peritracheal glands enlarged and lungs slightly involved; 4 = massive involvement of all glands, spleen, lungs and liver.

All the animals were sectioned one day after the second injection.

sible efficient and complete tissue contact which might not be the case were large lumps of bacilli used for injection. The detailed data of the findings are given in Table 1.

A careful survey of the results obtained in the above experiment and tabulated in Table I. indicate that the reaction of tuberculous guinea pigs, infected by subcutaneous injection, to a second (intraperitoneal) injection of living tubercle bacilli in amounts from 0.001 to 1.0 gram given 22 to 29 days after the primary (infecting) injection did not produce in these animals symptoms which were not obtained by similar intraperitoneal injection of tubercle bacilli in normal animals, or which were not obtained with large amounts (0.5 gram) of living staphylococcus aureus injected intraperitoneally into (non-sensitized) normal guinea pigs. In no case in this experiment was a typical acute anaphylactic reaction noted, such as is characteristic of the phenomenon when soluble proteins are used. In the larger doses (1.0 gram) living tubercle bacilli given intraperitoneally were found to be profoundly toxic, producing an acute and early death of the animal. A correlation was noted between the toxicity of living tubercle bacilli injected intraperitoneally into tuberculous guinea pigs and the amount of generalized tuberculosis existing in the guinea pigs at the time of injection. There was noted no difference in this respect between guinea pigs infected with one strain and given the subsequent intraperitoneal injection with the same strain of bacilli, human or bovine, or any other one of the five strains tested. The virulence of the strain used for the second injection also played no part in this.

In order to check further on the above experiments and also to determine whether, if any anaphylactic antigenic property existed in heat killed bacilli, a series of guinea pigs were given subcutaneous injections or different amounts of 1, 10, and 100 milligrams of heat killed human tubercle bacilli ("Human" an avirulent human bacillus and "Gluckson," a highly virulent human strain recently isolated from sputum) and virulent bovine bacilli ("Bov. virulent") and 25 days later these animals were given a second injection of the virulent human tubercle bacilli ("Gluckson") living and heat killed in amounts of 0.1 and 1.0 gram injected intraperitoneally. The bacilli were killed by placing the flask containing them in a boiling water bath for about one hour. In order to give due consideration to the presence of local tubercle, notation of this was made at the time of the second injection and recorded besides watching for any systemic changes in the animals. In no case was a systemic tuberculosis found in the animals examined within a few days after the second injection, although there was a marked peritoneal involvement from this injection. The local tubercles produced varied in size dependent upon the amount of the primary injection given. Tuberculin (O.T.) was incidently used in this experiment as an additional test for the antigenic value of the dead tubercle bacilli. The results of this second experiment are given in Table 2.

TABLE 2.

An Attempt to Produce Anaphylaxis with Living and Heat Killed Tubercle Bacilli and Tuberculin in Guinea Pigs Sensitized with Heat Killed Bacilli and Tuberculin

Second Injection (25 days later) intraperitoneal			First or sensitizing injection																			
			Amount of suspension of bacilli in milligrams injected subcutaneously on the left side of the chest																		O. T. injected intrap. in ccm.	
			Human Avirulent						Gluckson						Bov. Virulent							
			1		10		100		1		10		100		1		10		100		1	5
Organism	Amount	State of Bacilli	LS=	R–	LS	R	LS	R	LS	R	LS	R	LS	R	LS	R	LS	R	LS	R		
Gluckson	1 gm.	Living	–*	D** 36′	–	D 36′	3	D 5′	–	D 4′	1	D 1 d	2	D 3 d	–	D 36′	1	D 1 d	2	D 1 d	D 1 d	D 1 d
		Heat Killed	–	D 7 d	1	D 4 d	2	D 8 d	–	D 5′	1	D 1 d	3	D 1 d	–	D 36′	1	D 25 d	3	D 8 d	D 9d	D 1d
	0.1 gm.	Living	–	1	1	D 30 d	2	D 24 d	–	D 18 d	1	D 30 d	3	D 40 d	–	D 19 d	1	D 35 d	2	D 28 d	D 40d	D 34d
		Heat Killed	–	D 19 d	1	1	2	1	–	1	1	1	2	1	–	0	1	1	2	1	D 18d	0
Tuberculin	2 Cu. Cm.	Full Strength O. T.	–	0	1	0	3	0	–	0	1	0	3	0	1	0	2	0	3	0	0	D 2d
	5 Cu. Cm.	"	–	0	1	0	2	1	–	0	1	1	2	1	–	1	1	1	2	1	D 1d	D 1d

= LS indicates the local site of injection of the dead bacilli used for sensitizing.

– R indicates the results obtained following the second injection.

36′ indicates 36 hours; 4d indicates 4 days.

* Since dead bacilli produce a predominant local lesion at the site of injection only this is recorded as follows: – = no appreciable local lesion; 1 = a nodule about 1 millimeter in size; 2 = a nodule approximately 1 centimeter in size, and 3 = a nodule (frequently rupturing and discharging) about or over 1.5 centimeter in size.

** Since a case of true acute anaphylaxis was never seen in any of the guinea pigs injected with tubercle bacilli the results given are graded on the approximate basis of toxicity as follows: 0 indicates no discernable effect, 1 indicates animal visibly ill; 2 indicates animal very ill; and D indicates animal died at the time designated in brackets following the D.

An examination of Table 2 reveals that dead human (avirulent and virulent) and bovine (virulent) tubercle bacilli injected subcutaneously in amounts from 1 to 100 milligrams into guinea pigs do not act as antigens for the anaphylactic reaction on a second injection of living or dead human ("Gluckson") tubercle bacilli injected intraperitoneally in amounts of 0.1 to 1 gram 25 days later even though distinct local tubercles produced by the dead bacilli exist at the time of the second injection. Likewise a second injection intraperitoneally of full strength tuberculin (Koch's O.T. human) in amounts of 2 to 5 cubic centimeters produces no appreciable general anaphylactic reaction in guinea pigs given a primary subcutaneous injection of dead human or bovine tubercle bacilli 25 days prior. Guinea pigs given an intraperitoneal injection of tuberculin (Koch's O.T. human) in amounts of 1 to 5 cubic centimeters 25 days prior to a second intraperitoneal injection of 2 to 5 cubic centimeters of tuberculin, however, died within 1 to 2 days following the second injection although definite acute anaphylactic symptoms were not seen; the intraperitoneal injection of this amount of tuberculin acting in itself as a distinct peritoneal irritant.

SUMMARY

Tuberculous guinea pigs infected by subcutaneous injection do not react in a manner characteristic of general anaphylaxis to a second (intraperitoneal) injection of living tubercle bacilli in amounts from 0.001 to 1.0 gram given twenty-two to twenty-nine days after the primary (infecting) injection.

The symptoms obtained in the tuberculous animals were identical to those obtained in normal animals given the same intraperitoneal injection.

In no case was a typical acute anaphylactic reaction seen, such as occurs with soluble proteins.

In the larger doses (1.0 gram) living tubercle bacilli as well as dead (heat killed) bacilli given intraperitoneally were found to be profoundly toxic, producing an acute and early death of the guinea pig.

A correlation was noted between the toxicity of the living tubercle bacilli injected intraperitoneally and the amount of generalized tuberculous involvement existing in the guinea pigs at the time of injections.

No difference was noted between the reaction of guinea pigs infected (subcutaneously) with one strain (human or bovine) and given the second intraperitoneal injection with the same strain of bacilli or any other one of the five strains studied.

The virulence of the strain also was of no significance in producing a differential effect.

Dead human and bovine tubercle bacilli injected subcutaneously into guinea pigs in amounts from 1 to 100 milligrams, sufficient to produce distinct local tubercles, did not act as antigens for the general anaphylaxis reaction on second intraperitoneal injection of living or dead vir-

ulent human tubercle bacilli in amounts of one-tenth to one gram, or full strength tuberculin (O.T. human) 2–5 cubic centimeters, given twenty-five days later.

The anaphylaxis reaction in guinea pigs is not suited to differentiate various strains of human and bovine tubercle bacilli.

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BLOOD CHANGES DURING THE PROGRESS OF EXPERIMENTAL TUBERCULOSIS IN GUINEA PIGS*

By Lydia M. DeWitt, M.D., and Lauretta Bender

Chicago

Considerable work has been reported in the literature on the blood picture in human cases of tuberculosis, but the findings have been by no means uniform and in most cases do not represent regular and frequent examinations over long periods of time. The same thing is to a considerable extent true in the relatively few reports of the blood picture in experimental animals. However, diminution of erythrocytes with a greater decrease of hemoglobulin is usually reported. Lymphocytes are sometimes said to decrease in the blood as the disease progresses, and some workers report a diminution or absence of eosinophile leucocytes in very severe cases, an increase suggesting a more favorable prognosis. Because of the lack of uniformity, it seemed advisable to carry on systematic examinations of the blood in experimental tuberculosis of guinea pigs, carrying the study throughout the entire course of the disease. It was also hoped that so uniform a blood curve of pure unmixed and unaltered tuberculosis might be found that the changes of blood curve might be studied as a valuable index of the effect of treatment with certain drugs in chemotherapy of tuberculosis. The usual methods employed in clinical medicine were used on the guinea pigs to determine red cell count, hemoglobin, white cell count and differential count. Some study was also made of coagulation time, Arneth's index, and of certain cell inclusions, especially the Kurloff bodies, and their relation to the rest of the blood curve.

The examinations were begun at or near the time of inoculation with tuberculosis and continued at fixed intervals during the life of the animals. These intervals have been in some cases weekly, in others biweekly and in some monthly.

Normal counts.—Seven uninoculated, nontuberculous and supposedly normal guinea pigs were first used as standards, about 90 counts being taken. The curves in these were quite smooth, except in two animals which developed an acute infection and were killed.

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The erythrocyte count was from 5,700,000—6,300,000.

The hemoglobin count was from 88 to 98 per cent.

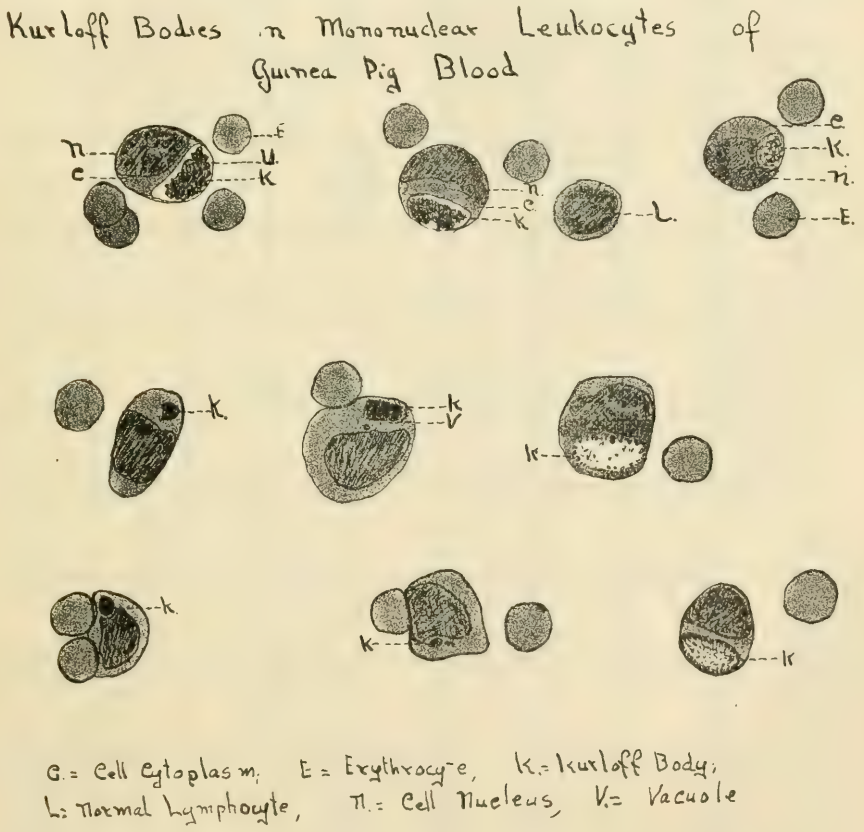
The total leucocyte count was 10,000—18,000.

The lymphocytes varied between 5000 and 8000 or about 35—50 per cent. of all the white blood cells.

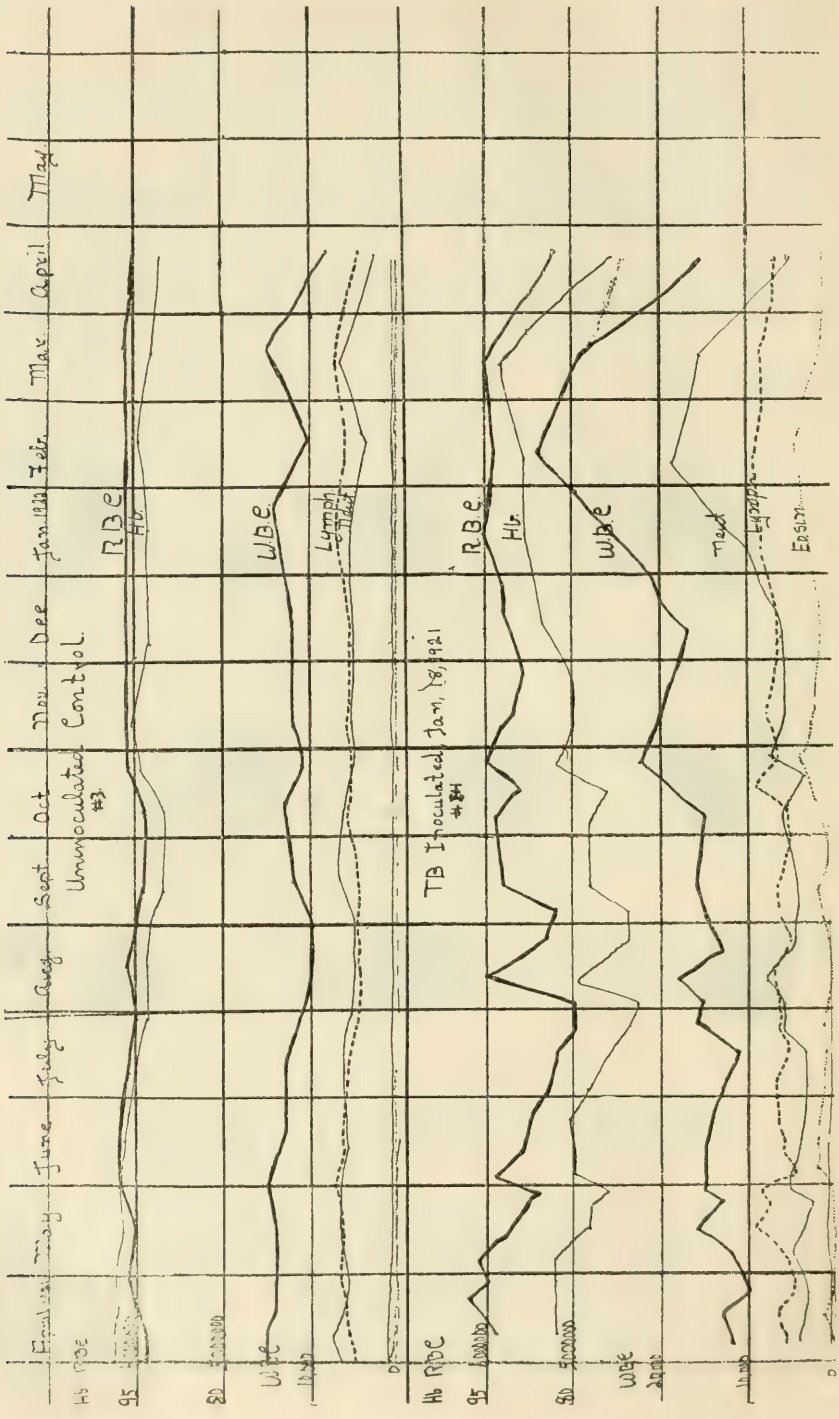
The neutrophiles also vary with the white cell count.

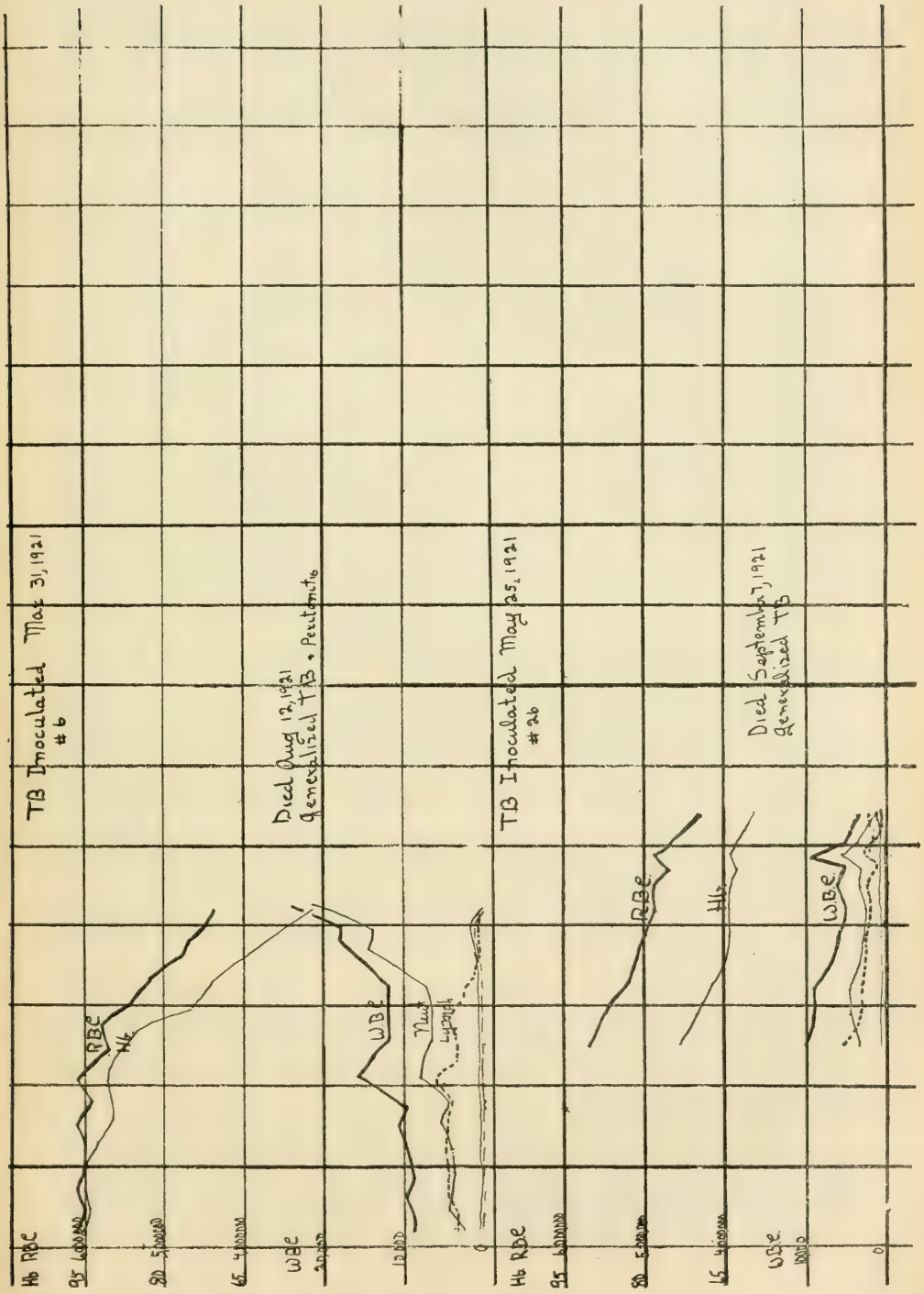
The large mononuclears, transitionals and the eosinophiles were each less than 1000, while the basophiles were from 1—2 per cent. of the white blood cells.

Of the five pigs left uninfected, four showed Kurloff bodies in their mononuclear cells during the last four months, the number of cells con-


Kurloff Bodies in Mononuclear Leukocytes of Guinea Pig Blood
C. = Cell Cytoplasm, E = Erythrocyte, K. = Kurloff Body;
L. = Normal Lymphocyte, N. = Cell Nucleus, V. = Vacuole

taining them being from 1—4 per cent. of the total white cell count. Pappenheim, in 1910, described these cells as azurophiles and the bodies as collections of azurophile granules. Woodcock in 1921 suggests that they are the result of an unsuccessful attempt of the lymphocytes of the guinea pig to digest red corpuscles. In these same four supposedly normal guinea pigs a marked eosinophilia developed nearly coincidently


Unvaccinated Control #3
TB Inoculated Jan. 18, 1921 #84
RBC
Hb.
WBC
Lymph.
Mon.
Eosin.
Hb RBC
WBC
Lymph
Mon
Eosin
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
Dec.
Jan.
Feb.
Mar.
April
May
June
July
Aug.
Sept.
Oct.
Nov.


TB Inoculated May 31, 1921
#6
Died Aug 12, 1921
generalized TB • Peritonitis
TB Inoculated May 25, 1921
#26
Died September 7, 1921
generalized TB
Hb RBC
WBC
Neut
Lymph

with the observation of the Kurloff bodies. These same inclusion bodies have been seen in numerous other normal or apparently normal guinea pigs and they are usually associated with a more or less marked eosinophilia and have apparently nothing to do with tuberculosis.

The tuberculous animals have been roughly divided into two sets, the chronic cases which were inoculated with relatively small doses of a culture of rather low virulence and which lived over four months, and the acute. Eleven animals of the chronic type were used, but as four died of causes other than tuberculosis, only seven were counted. The main points of variation from the normal were (1) anaemia, the red cells diminishing somewhat, but the hemoglobin much more; (2) decrease of lymphocytes toward the end of life; (3) pronounced eosinophilia as the disease progressed, in nearly every case; (4) Kurloff bodies present in most cases in the last four months. Since eosinophilia occurs usually with Kurloff bodies, we can not lay so great stress upon it, but it seems characteristic of chronic tuberculosis whether the bodies are present or not. Four cases of chronic tuberculosis treated with one of my organic mercury preparations have been examined during several months. In most respects, they have followed the curve of the other chronic cases, becoming more like the acute toward the end. In one respect they have differed however, in that no eosinophilia has developed, although in addition to the chronic tuberculosis, they have shown large numbers of Kurloff bodies. Further study is necessary to determine whether the absence of eosinophilia was due to the mercury treatment.

The acute cases studied, of which there were fourteen, were those in which, by reason of larger doses or more virulent strains, tuberculosis developed more rapidly and the animals died within four months. The more rapid the progress of the disease, the more profound were the blood changes. In these animals, the number of erythrocytes steadily decreased to 4-5,000,000 or less, the hemoglobin diminishing more rapidly to 40—65 per cent.

Leucocytes: The neutrophiles sometimes increased to 20,000 and in some cases diminished to 2500.

The lymphocytes steadily decreased to 1000 or less.

The large mononuclears and transitionals showed a slight increase shortly before death.

The eosinophiles were diminished or absent except in one case which lived nine months and showed a type of blood changes more similar to those of the chronic cases, including a slight eosinophilia. No Kurloff bodies were found in any of these acute cases, but one was found in this one more chronic case.

The presence or absence of the Kurloff bodies, however, probably has nothing to do with the acuteness or chronicity of the cases since a number of cases of acute tuberculosis treated with mercury chaulmoograte and with methylene blue, the blood of which has been examined, during the last few months, have Kurloff bodies, while none of the ani-

mals examined last summer had any. These last treated animals while not included definitely in this report, have shown no eosinophilia.

Coagulation time: In uninoculated guinea pigs, the coagulation time varied from 4½ to 6 minutes, with the greatest number of examinations at 5 minutes. Those having an acute infection showed a slightly increased coagulation time of 6 to 7½ minutes.

In the cases of chronic tuberculosis, the counts varied between 4 and 7½ minutes, with the largest number at 5½ and 11 of the 40 examinations showing the time over 6 minutes.

The cases of acute tuberculosis showed coagulation time between 4 and 11 minutes, 9 of the examinations during the last 4 weeks before the death of the animals showing a time between 8 and 11 minutes.

Apparently, then, in guinea pigs the coagulation time is slightly increased in chronic tuberculosis and nearly doubled in the later stages of acute tuberculosis.

The Arneth counts show in the normal guinea pigs from 401—504 or an average of 452 nuclear parts to 100 polymorphonuclear cells; in chronic tuberculosis the range is slightly lower, the average being 426, while in acute cases, the range is 276—406 with an average of 361 nuclear parts to 100 cells. While this work needs further study, apparently a low number of nuclear parts is associated with diminished resistance of the animal and with a bad prognosis, while an increase seems to mean an improvement in general condition.

The coagulation time in tuberculosis of men is usually reported as not much changed except after hemorrhages.

The Arneth index is stated by Klebs and by others to shift to the left in human cases of tuberculosis especially in the second stage. This corresponds to a diminution of nuclear portions and hence corresponds to our finding in tuberculosis, especially in acute cases and in chronic ones which are growing worse.

Our work on treatment has not progressed far enough for us to say definitely whether the blood curve can be used as an index of therapeutic effects, but it seems possible that it may be used in connection with weight curve to determine the condition of the pig and how it is being affected by a given treatment.

NONSPECIFIC CROSS-FIXATION OF COMPLEMENT WITH WASSERMANN AND TUBERCULOSIS ANTIGENS*

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(Abstract)

Routine Wassermanns and tuberculosis complement fixation tests were run on 100 tuberculous sera, and 800 specimens of blood received at the Public Health Laboratory, University of Missouri, for Wassermann tests. The 100 sera of the first group were from clinically active tuberculous patients who gave neither history nor evidence of syphilitic infection. A 0.4 per cent. cholesterinized antigen and a plain alcoholic antigen were used. Eight of the 100 tuberculous sera gave positive Wassermanns with the cholesterinized antigen. The 800 sera of the second group included 271 positive Wassermanns and 529 negative results. Thirty-two of the 271 Wassermann-positive sera gave fixations with tuberculosis antigen. Of this number, 19 (7 per cent.) were from frankly or suspected syphilitic cases who gave neither history nor evidence of tuberculosis. Of the 529 Wassermann-negative sera, 32 gave fixations with tuberculosis antigen. This number included 13 "normal" individuals with neither history nor evidence of syphilis or tuberculosis, 2½ per cent. of the 529 sera. These fixations with tuberculosis antigen are regarded as specific reactions, probably due to old or latent foci of infection. It is suggested that the higher percentage of positive reactions among the Wassermann-positive group may be due to activation of old or latent tuberculosis infections by the bodily injury from the invading spirochetes or to vigorous anti-syphilitic treatment.

The positive Wassermanns, among the known tuberculous non-syphilitic sera, are regarded as cross fixations for which no satisfactory explanation is offered. A positive Wassermann reaction with only a cholesterinized antigen in the case of a known tuberculous serum is not to be accepted as indicative of syphilis without thorough investigation, because of the fact that an active tuberculosis may give a non-specific reaction with a cholesterinized antigen. While the cholesterinized antigen is valuable for routine Wassermann work, especially in old or treated syphilitic cases, such results should be checked with a less sensitive antigen. An acetone insoluble antigen is considered a good one.

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This paper has been published in full in the American Review of Tuberculosis.

STUDIES ON THE RELATION OF MINERAL DUSTS TO TUBERCULOSIS*

II The Relatively Early Lesions Produced by the Inhalations of Marble Dust and Their Influence on Pulmonary Tuberculosis.

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The general consensus of opinion has been that those exposed in industry to the inhalation of calcigerous dusts are not especially prone to pulmonary tuberculosis. Typical of this belief is a paper by W. T. B. Selkirk, who observed that tuberculosis is rare among the lime workers about Edinburgh. Fissak reports that of 40,824 deaths among lime and gypsum burners only 17 or 0.41 per cent. were due to tuberculosis. He also claims that among 400 employees in a gypsum factory no death from tuberculosis occurred in 17 years. On the other hand, Frederick L. Hoffman states that from a statistical view-point, "the proportional mortality from pulmonary tuberculosis is exceedingly high among marble cutters and polishers." This discrepancy, as will be shown below, may be accounted for by differences in the dust from various sources.

Our own studies on the effect of inhaled mineral dusts and their relationship to pulmonary tuberculosis were the outcome of an attempt to influence the course of this disease by marble dust inhalations. This investigation was soon extended to include several other types of mineral dust, on one of which (granite dust) we have already made a preliminary report. The present communication will deal with the results of similiar experiments on marble dust.

Several observers have worked with other calcigerous dusts, such as cement, gypsum, mother of pearl, limestone and plaster of Paris, but as far as can be determined no one has investigated the action of marble dust under experimental conditions.

The plan of our experiments was the same as that employed in the investigation of the action of granite dust which was reported before this Association two years ago. Guinea pigs were exposed in a chamber in the bottom of which was a hopper provided with a revolving paddle. In the hopper was a certain amount of dry marble dust and above and on each side of it were trays on which the animals rested. Power was supplied by a motor causing the paddle to revolve and raise a fine cloud of dust in the machine. The usual period of exposure was eight hours

* From the Saranac Laboratory for the Study of Tuberculosis.

per day which was continued for seven months or more. The animals were infected by the inhalation of a moist spray containing the low virulent R_1 strain of tubercle bacilli. Infection was timed in varying relationship to the dust inhalation and the animals were killed at different intervals.

The dust was supplied in large quantities by the Vermont Marble Company. Physically it consists of a fine white powder from which a cloud of dust arises on agitation. Microscopically it is composed of flat irregular broken crystalline plates which are doubly refractile. It is dissolved by dilute acids with the evolution of gas. A chemical analysis shows that it contains about 89 per cent. of calcium carbonate and, besides traces of other substances, 1.9 per cent. of crystalline silicia.

To determine the concentration of the dust suspended in the atmosphere of the dusting chamber, measurements were made with a Palmer Apparatus which was kindly lent by the U. S. Public Health Service. As the result of these measurements it was determined that the experimental atmosphere contained approximately 220,000 times as many dust particles as an atmosphere ideal for human consumption. The ideal standard was one which Professor Winslow believes could be maintained in a polishing shop, whose atmosphere was heavy with carborundum dust, by the use of suitable exhaust devices.

As infecting agent the low virulent strain of tubercle bacilli known in our laboratory as R_1 was employed. Pulmonary infection following the inhalation of this organism tends to persist as discrete subpleural tubercles which progress to a stage of caseation and then after a variable period of time, undergo resolution and the lung is restored to its normal condition. As the concentration of organisms in the tracheobronchial lymph nodes is much heavier than in the lungs, the lesions persist in them for a much longer period. In the simple infection controls employed for this experiment, (which was the same as that controlling corresponding granite experiments) resolution had commenced at two months and was practically completed at six or seven months.

A small group of eleven normal animals was exposed only to the inhalation of marble dust. In their lungs no such large accumulation of phagocytes could be found as occurred in corresponding animals exposed to granite. Within the alveoli only scattered cells could be detected—perhaps four or five to a high power microscopic field. The number of such cells slowly increased as the exposure progressed and at the same time the peripheral lymphoid tissue underwent active hyperplasia. Animals killed at intervals after the cessation of the dust exposure showed progressively fewer cells of this character. After two months practically none were left in the air passages but all were to be found within hyperplastic lymphoid tissue located in the periphery and central portions of the lung and in the tracheobronchial lymph nodes. The phagocytic cells were of the type, usually encountered in the lung: they contained either small yellow-brown amorphous or crystalline

doubly refractile particles strongly resembling the crystalline silicia seen in such quantities in the lungs of the granite animals.

In a preliminary experiment there were nine animals which had received a heavy R_1 inhalation infection seven months previously. As the tubercles in these animals were already composed chiefly of scar tissue at the time when the dust exposure was started they were in no way influenced by the dust.

A second experiment was made to study the reaction of the guinea-pig's lung to relatively brief exposures of the dust. Eight animals (Group A) were infected by inhalation of the R_1 bacilli and on the following day they were exposed to dust which was continued for a period of forty-six days. The animals were killed at intervals during the exposure. In this period there was no appreciable alteration in the character of the tubercles but as will be shown below there was a definite increase in their number.

Sixteen animals (Group B and C) were subjected to a sixty day dust inhalation and were then infected. Half of the animals (Group B) were set aside for seventy-five days without further treatment; while with the other half (Group C) the dust exposure was continued for the same period. The only difference noted between Groups B and C was that in the latter the lesions were slightly larger. When they were studied microscopically the cause of this enlargement was apparent. About each tubercle was a narrow zone of alveoli partially filled with cell plaques containing a certain quantity of foreign particles.

In comparing these animals with those of other series it was immediately apparent that lungs which had been exposed to marble dust presented more surface tubercles than did those of the simple infection control series, but not as many lesions as did the lungs of the granite animals. Macroscopic counts were made of the number of these tubercles in each series. The following are the averages of the counts of eight lungs in each group.

Series	Group A	Group B	Group C
Granite	51	94	102
Marble	26	55	62
Controls	15	15	15

In addition to this increase in surface tubercles, these animals exposed to dust showed a definite tendency to form tubercles in the depths of the lung. In the controls such lesions were rare, in the marble animals a few tubercles occurred in this location, while in the granite series they were very numerous.

The course of the tuberculosis in guinea-pigs exposed to marble dust resembled that in the granite series in that the resolution process was delayed. In the normal control series resolution commenced at the second month and was practically completed by the sixth or seventh month. In the marble animal it was delayed by at least two months, so that at the end of the seven month period most of the tubercles were still composed of considerable collections of connective tissue.

In a third experiment, fourteen guinea-pigs were infected by inhalation with R_1 tubercle bacilli. On the following day they, together with eleven normal controls, were placed in the dusting chamber and were subjected to daily exposures for seven and one half months. A few pigs were killed during the course of this exposure to observe progress of the experiment and others after cessation of exposure to dust inhalation. As there was no macroscopic departure from the usual, the animals were again exposed for a short period, some were killed and others preserved for a third dusting. The last animals were killed two years after their infection. In addition to the changes already noted in the previous experiments, one of the last pair showed a chronic ulcerative tuberculosis which is extremely rare after R_1 infections. In seven of ten tuberculous animals killed five months or more after infection, there were occasional small deposits of calcification within the caseous centres of tubercles in the lungs or tracheobronchial lymph nodes. In two animals deposits of calcium salts were detected in the bronchial cartilages; the tissues of the remaining five were not so fixed that the calcium salts in this location could be positively identified. In no normal animal was any trace of calcium detected. Moreover the lungs and lymph nodes of animals in other experiments and in the undusted infection controls were examined in search of calcification but only once could it be detected. This occurred in all the tubercles of an R_1 inhalation animal of another experiment which died eight and one half months after infection.

In studying sections made from the lungs of these animals one is impressed by the small number of dust particles within the tissues. Measurement has shown that the particles are small enough to be inhaled into the alveoli, and the granite experiment convinced us that such small particles could, under similar conditions, penetrate into the alveoli. The obvious conclusion is that much of the dust must be soluble in the lung tissue. Wells in his Chemical Pathology states that calcium salts may be dissolved in the presence of an excess of CO_2. Analysis has shown that 89 per cent. of marble dust is calcium carbonate and over 5 per cent. is magnesium carbonate. These substances are undoubtedly dissolved and taken into the blood and lymph streams due to such an excess of CO_2. The insoluble residue, containing nearly 2 per cent. of silica is phagocyted as in the granite experiment and it is probable that these were the particles which were detected in the lung tissues. When inhaled over long periods it is quite conceivable that by cumulative action these small increments of silicious dusts could initiate a slow but progressive silicosis. To the action of such small amounts of silicious matter we must therefore ascribe the increase in the number of pulmonary tubercules and also the increased size of these lesions. The reaction is that of the granite dust in kind if not in degree.

The soluble portion of the marble dust, the calcium carbonate, enters the blood stream and is stored in some, as yet undetermined, organ in the body. Where tissues have been injured by the tubercle bacillus these calcium salts are percipitated in greater or less amounts.

To capitulate: marble dust may be divided according to its chemical composition into two portions, one insoluble and largely composed of silica and the other, soluble and composed chiefly of calcium carbonate. The soluble portion if inhaled over a sufficiently long period will be followed by the calcification of caseous foci produced by infection with the tubercle bacillus. The insoluble portion though very small in amount is nevertheless capable of producing a very definite injury to the pulmonary tissues, even in the relatively short period of this experiment. This effect is manifested by an increase in the number and size of such tubercles.

We may, therefore, conclude that the inhalation of marble dust is dangerous in so far as that dust contains silica. Under the conditions of this experiment, calcification, while not a uniform occurrence is, nevertheless, much more common than has been noted in any of our previous experiments.

Applying these results to industrial conditions we can assert that marble dust is injurious in so far as it contains crystalline silica. Even small amounts of this material when inhaled over a prolonged period will be followed by a silicosis with its accompanying predisposition to pulmonary tuberculosis. While no data are at hand to prove the contention, the evidence furnished by these experiments would lead one to expect an increased incidence of calcified tubercules in the lungs of the marble worker.

In the inhalation of marble dust we may distinguish two counter agencies, opposed in their reaction to the tuberculous lesion, the one, silica, tending to favor the implantation of this disease and the other, calcium carbonate, tending to produce healing in such lesions when once they become established.

SOME FACTORS CONCERNED IN THE DISSEMINATION OF TUBERCULOSIS IN EXPERIMENTAL ANIMALS*

By Samuel R. Haythorn, M.D.

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(Abstract)

In 1913, the author reported the results of some studies on the formation of miliary tubercles made by the simultaneous injection of tubercle bacillus emulsion and Higgin's india ink. This method has been used in the study of various points since that time. The object of this present paper was to emphasize the importance of cells in the distribution of tubercle bacilli throughout the body of the experimental animal, the pigment being used as a means of following the cells from one portion of the body to another. The work was illustrated by the demonstration of the following lantern slides.

Slide 1. Photograph of a glomerulus of the kidney showing the capillaries filled with masses of free tubercle bacilli. This slide was shown to emphasize the fact that the extra-cellular transportation is not questioned.

Slide 2. Photograph of a large mononuclear leucocyte of the blood containing india ink pigment granules. This cell was found during the differential count made on the blood of an animal which had been injected intraperitoneally with india ink.

Slide 3. Photograph of a perivascular tubercle of the lung extending into the lumen of the vessel. The extension consisted of masses of proliferative endothelial cells which contained tubercle bacilli. The ease with which such cells might be swept into the blood stream is easily imagined.

Slide 4. Low power photograph of the groin of a guinea pig showing the reaction at the site of injection.

Slide 5. High power photograph showing a tubercle formed at the site of innoculation from cells containing both india ink pigment and tubercle bacilli.

Slide 6. Oil immersion photograph of a cell containing pigment granules and a tubercle bacillus.

* From the Pathologial Laboratories, University of Pittsburgh.

Slide 7. High power photograph of an early tubercle formed from pigmented cells in an inguinal lymph node near site of injection.

Slide 8. Gross photograph of a guinea pig showing tuberculous glands in the inguinal region and the intimate vascular connections between the blood supply of the abdominal and thoracic areas.

Slide 9. Gross photograph of the sternum of a guinea pig innoculated with tubercle bacilli in the groin showing extension of tubercles to the sternal lymph nodes.

Slide 10. Photograph of a section of a sternal lymph node showing its relation to the intercostal cartilages.

Slide 11. Photograph of a section of sternal lymph node showing numerous early tubercles made up largely of pigmented cells.

Slide 12. Photograph of perivascular lymphatics near sternal lymph nodes containing numerous pigment bearing cells. These cells were found upon oil immersion examination to contain tubercle bacilli. The animal, from which this slide was made, died eight days after innoculation in the groin with india ink and tubercle bacilli.

Slide 13. High power photograph of early tubercle in sternal lymph node made up largely of pigmented cells. This animal was innoculated in the groin 17 days previous to death. No polymorphonuclear leucocytes and no caseation necrosis were present in the early tubercles at this time.

Slide 14. Photograph of a high power drawing from the above section. The large mononuclear cells were found to contain both tubercle bacilli and pigment granules.

Slide 15. Photograph of a tubercle showing early caseation necrosis. Many polymorphonuclear leucocytes were seen and when examined with the oil immersion lens, it was found that the polymorphonuclear leucocytes contained numerous tubercle bacilli.

Slide 16. Photograph of a drawing of an area of caseation necrosis in which both the polymorphonuclear leucocytes and the large mononuclear leucocytes contained tubercle bacilli.

Slide 17. Photograph of a smear of one of the caseous areas showing polymorphonuclear leucocytes which had phagocytosed from four to eight pigment granules each.

Slide 18. Photograph of a drawing of a smear from a caseous lymph node showing polymorphonuclear leucocytes which had phagocytosed tubercle bacilli.

Slide 19. Photograph of a subcapsular liver tubercle from a guinea pig innoculated intraperitoneally with pigment and tubercle bacilli. As this tubercle was made up largely of pigmented cells it indicates that both wandering cells and the fixed cells of the liver tissue may take part in the formation of tubercles.

Slide 20. Photograph of large mononuclear cells filled with pigment which were compressed between thick bands of connective tissue and

appeared to have changed into connective tissue cells. The section was made from a rabbit's ear which had been injected several weeks previously with india ink pigment.

Slide 21. Photograph of a rabbit's ear which had been treated as described under slide 20, save that the ear had been immersed in water at 65°C. for five minutes on the day previous to killing the rabbit. The section showed that when the compression of the connective tissue had been removed the pigmented cells resumed their spheroidal shape and were seen to be lying free in the spaces.

Slide 22. Photograph showing compression of pigmented cells by connective tissue in the periphery of an experimental tubercle, resembling those seen in slide 20.

Slide 23. Photograph showing the effect of an artificially produced edema upon the pigmented cells in the periphery of an experimental tubercle.

Slide 24. High power photograph of the large pigmented cells in an edematous area near a tubercle. The union of large pigmented cells in the formation of giant cells was illustrated. In this instance the giant cells were formed by fusion of the large mononuclear cells as was shown by the accumulation of the pigment granules in the neighborhood of the nuclei of the fusing cells.

CONCLUSIONS

1. Large mononuclear cells of endothelial origin are important agents in the dissemination of the tuberculous infection in experimental animals.
2. These cells phagocyte tubercle bacilli in infected foci and carry them to neighboring tissues and through the lymphatic channels to the lymph nodes where they may initiate new lesions. Less commonly they may gain entrance to the general circulation and transport tubercle bacilli within the blood vessels and sinuses.
3. Experimental evidence was obtained to show that tubercles are occasionally formed almost entirely if not wholly from wandering cells, that is, without obvious proliferation on the part of the endothelium of the fixed tissues of the area.
4. Polymorphonuclear leucocytes phagocyte tubercle bacilli in caseous areas but there is little evidence of their importance as carriers or distributors of the disease.
5. The intracellular transportation of tubercle bacilli has a wide application in the finer interpretation of tuberculous processes.

OBSERVATIONS ON THE RESISTANCE OF GUINEA-PIGS TO EXPERIMENTAL TUBERCULOUS INFECTION*

By Raymond G. Hussey, M.D.

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In a previous communication from this laboratory it has been reported that white mice when exposed to dry heat before an inoculation of a massive dose of bovine tubercle bacilli outlived control mice similarly inoculated but not heated. The difference in the average length of life in days of the two groups was striking enough to be significant.

Since the information we have at our disposal regarding the natural history of experimental tuberculous infection in this species of animal indicates that the disease is characterized chiefly by a form of septicemia that is rapidly fatal, it would seem that the results observed in the experiments reported might be interpreted on the basis of a modified type of the usual disease. That is, through the effect of the dry heat some physiological mechanism is established which enables the tissues of the host to resist the early effect of the parasite, but not capable of ultimately resisting the development of further lesion. This point of view suggested the application of the heat method to the study of tuberculous disease in the guinea-pig.

In this animal not only is the natural history of experimental tuberculous infection well known but we have at our disposal a further advantage of fairly exact information regarding the reaction of these animals to the Saranac Strain H37 tubercle bacilli. It may be recalled in this connection that the observations of Trudeau, and later those of Krause, on the course of infection and disease following inoculation of this strain reveal the interesting fact that the character and the distribution of lesions is so regular that it is possible to anticipate with a good degree of accuracy the anatomical diagnosis for given periods of time.

The plan of our experiment was as follows:

(1) A group of animals of approximately the same weight were inoculated simultaneously with equal amounts of the same suspension of tubercle bacilli.

(2) Heat treatments were commenced when fully established active tuberculous infection existed, at which time we assume progressive tuber-

*From the laboratories of the Rockefeller Institute For Medical Research.

culous disease also. Similar treatments were given at intervals of 15 days following the initial one.

(3) As controls some animals were similarly inoculated but were given no heat treatments.

(4) All animals were allowed to die naturally and autopsies were made to observe the distribution and character of the lesions.

Sixty guinea pigs weighing between 225 and 260 grams were inoculated subcutaneously into the groin with 0.1 cc. of a suspension of strain H37 tubercle bacilli, human type. The suspension was prepared so that a stained film preparation showed not more than two bacilli to a microscopic field. The culture was a three weeks' growth on Petroff's Egg Medium. Three weeks after the inoculation, when the inguinal lymph nodes were distincly palpable, 47 of the animals were heated for 15 minutes at a temperature not higher than 45 degrees Centigrade and not lower than 40 degrees. This procedure was repeated at the intervals previously stated. Ten animals were reserved as controls.

At autopsy the control animals showed dessiminated tuberculosis particularly evident in the spleen, liver and lymph nodes. The lungs of those animals living the longest showed scattered translucent tubercles. In the longest-lived controls the spleen also presented the picture so frequently described, namely, there was so much enlargement that the entire anterior part of the abdomen was occupied by this organ in which scarcely any normal splenic pulp was to be seen. In all of the controls the inguinal lymph nodes were greatly increased in size, they were soft and in many instances were merely encapsulated masses of soft caseous material. The livers showed the usual wide-spread involvement.

In striking contrast to this picture the autopsies on heated animals revealed relatively slight tuberculosis in the spleen. The lymph nodes showed fibrosis and in some instances calcification. In the livers marked fibrosis was also observed. In two instances, however, tuberculous cavities were observed. The lungs of these animals presented most interesting varieties of chronic ulcerative pulmonary tuberculosis and caseous pneumonia. These lesions resembled those characteristically found in human tuberculous infections, i. e., cavitation, consolidation, etc.

These results are interpreted to indicate that through the agency of dry heat the tissues of the guinea-pig which are usually very susceptible to tuberculous infection are rendered capable of combating the disease to a remarkably successful degree. It is in this sense that we use the word "resistance" as a defining term. Although we have this evidence of resistance in the tissues usually susceptible we have at the same time evidence of apparent marked susceptibility in the lung tissue generally considered to show but little lesion in the guinea-pig. The question naturally arising is whether the lung tissue is really more susceptible in the heated animals or whether the fact that pulmonary tuberculosis is not usually observed in guinea-pigs may be accounted for on the basis

of time alone. That is, whether the usual widespread visceral type of disease is terminated by death before the pulmonary lesions have time to develop fully. Evidence bearing on this point contained in the literature reviewed by the writer does not support this view. In fact no records have been found which report such lesions as we have observed.

We conclude, then, that we have observed a very definitely modified type of tuberculous disease in the guinea-pig which is associated with the effect of dry heat. Just what this effect is we are not prepared to state. Neither can a satisfactory interpretation of the pulmonary lesions be given at this time. A detailed account of our experiments together with illustrations will soon appear in the *Journal of Experimental Medicine.*

STUDIES IN THE CHEMOTHERAPY OF BACTERIAL INFECTIONS*

III. EXPERIMENTAL TUBERCULOUS PLEURITIS AS AN AID TO CHEMOTHERAPEUTIC INVESTIGATIONS IN TUBERCULOSIS

By John A. Kolmer, M.D., and Isamu Ogawa, M.D.

Philadelphia

A successful chemotherapy for tuberculosis has not yet been developed. Despite the fact that many compounds possess high tuberculocidal activities *in vitro,* none has demonstrated constant curative activities in experimentally infected animals. Probable reasons are high toxicity preventing the administration of curative amounts of the medicaments and their inaccessibility to the bacilli in tuberculous lesions. No field in medicine, however, is more worthy of investigation than chemotherapy in tuberculosis by reason of the tremendous importance of this disease.

Chemotherapeutic experiments in tuberculosis have been generally conducted with guinea pigs and rabbits. Generalized lesions involving the lungs, spleen, liver, lymph nodes, etc., are produced by subcutaneous or intraperitoneal inoculations of virulent bacilli. Under proper conditions the disease is certain to develop and terminate fatally in a month or more, but no known drug can be said to favorably influence the experimental disease in a constant mannner.

PURPOSE OF INVESTIGATION

The purpose of this investigation was to discover a method of producing the disease in animals more favorable for the demonstration of possible curative effects of medicaments developed in the course of chemotherapeutic investigations.

As shown by Kolmer and Idzumi,[1] in the treatment of experimental pneumococcus meningitis in rabbits and dogs by subarachnoid injections of ethylhydrocuprein hydrochloride, and by Kolmer and Sands[2] in the treatment of experimental pneumococcus pleuritis of guinea-pigs and

* From the Dermatological Research Institute of Philadelphia and the Pathological Laboratories of the Graduate School of Medicine of the University of Pennsylvania.

This paper *with illustrations* is being published in the American Review of Tuberculosis.

dogs with the same compound, it would appear that localized lesions of serous cavities are more amenable to treatment and offer more sensitive indices of therapeutic activity on the part of a medicament than generlized infections and bacteremias. Amounts of drug, one-half or less than the maximum tolerated doses, may be injected into such cavities to render the contents distinctly bactericidal and curative, whereas intravenous injection of similar amounts are without demonstrable therapeutic effects, owing, in part, to higher dilution in the blood. For these reasons one of us (Kolmer) has advocated the use of localized lesions in chemotherapeutic studies in bacterial infections, when the margin between *dosis curative* and *dosis tolerata* is small.[3] In serum therapy and in chemotherapy with arsenical compounds in experimental spirochetal and trypanosomal infections, generalized infections may be employed because the margin between *dosis curativa* and *dosis tolerata* is sufficiently great to permit the administration of large and sterilizing doses, but in bacterial chemotherapy more or less localized lesions appear to be somewhat more favorable for eliciting the possible therapeutic effects of a medicament.

In this connection it may be stated that Gay and Stone,[4] attracted by the frequency of streptococcus empyema in recent years, have successfully produced experimental empyema in rabbits and used the lesion to study the curative effects of vaccine and serum therapy. More recently Gay and Morrison[5] have continued this work with a study of the curative influence of certain dyes but with negative results up to the present time.

The ideal lesion is one that is strictly localized, such as pleuritis: extension to the lung, mediastinal nodes and pericardium by lymphatic absorption and direct continuity of tissues is to be expected, but bacteremia and metastases to distant organs, such as the spleen, liver, kidneys and meninges, are undesirable.

If such lesions are produced in a uniform and constant manner, the medicaments under study may be injected in appropriate amounts directly into the serous cavities at varying intervals after injection of the test microörganisms.

It is to be remembered, however, that the toxicity of substances injected into a normal pleural cavity is generally the same or slightly greater per gram of body weight than that observed upon intravenous injection.[6] In the presence of pleuritis the toxicity of a medicament varies to a considerable extent. Toxicity is sometimes decreased, probably by dilution and modification with pleural exudates and interference with absorption; frequently, infected animals cannot bear the usual dose owing to a reduction in resistance by the effects of infection.

METHOD OF STUDY

We have used different strains of human and bovine types of tubercle bacilli injected into the right pleural cavities of guinea-pigs, rabbits, rats and dogs.

These strains* were of moderate virulence for the susceptible animals and have been employed for many years in the preparation of tuberculin.

Our method was to secure growths by filtering glycerin-veal-broth cultures, employed for the preparation of tuberculin, and suspending the bacilli in sterile saline solution or broth. The suspensions were well shaken to secure homogeneous preparations, but, owing to the difficulty of securing suspensions sufficiently homogeneous to facilitate counting, the densities were controlled by comparison with the McFarland nephelometer. The approximate counts were as follows:

No. 1:	150,000,000 bacilli per cc.	No. 4:	800,000,000 bacilli per cc.
No. 2:	260,000,000 bacilli per cc.	No. 5:	900,000,000 bacilli per cc.
No. 3:	500,000,000 bacilli per cc.	No. 8:	2,800,000,000 bacilli per cc.

Varying amounts of these suspensions were injected into the right pleural sacs. Records were kept of the weights of each animal. Necropsies were made of all animals, as well as careful macroscopic and microscopic examinations of the pleural, pericardial and peritoneal exudates and of the thoracic and abdominal organs. Microscopic examinations were made of all organs because tubercles were sometimes discoverable in the lungs, spleen, liver, kidneys, diaphragm, etc., when the naked eye appearances were approximately normal. *With few exceptions all animals were examined within a period of five weeks after infections. This is important in relation to the subject of metastatic lesions in distant organs.*

RESULTS

1. Pleural infections of guinea pigs with bovine and human tubercle bacilli. The results are summarized in tables 1 and 2 which show the amounts of exudate found in the serous cavities and the distribution of tuberculous lesions.

With the bovine bacilli right-sided pleuritis and pneumonitis were produced in every animal. The majority showed pleural changes on the left side and tubercles were found in the left lungs of all animals. The pericardium was involved in the majority of animals. As previously stated, the bacilli were injected into the right pleural cavity, but, as was found by Kolmer and Sands in experimental pneumococcus pleuritis, bilateral lesions were invariably produced.

The strain employed (while of moderate virulence for guinea pigs by subcutaneous injection) was sufficiently aggressive, to invade thoroughly not only the tissues of both lungs, but likewise distant organs, such as the spleen (70 per cent.) and liver (43 per cent.) of these animals;

* We are indebted to Dr. Fred Boerner, Director of the State Livestock Laboratory of Pennsylvania, and Mr. F. Glenn, of the Mulford Biological Laboratories, for these cultures.

tubercles were not found in the kidneys, although the latter frequently showed other histological changes.

TABLE 1

*The results of injecting bovine tubercle bacilli (strain H) into the right pleural cavities of guinea pigs**

NUMBER	DOSE OF BACILLARY SUSPENSION (CC.)	DURATION (DAYS)	EXUDATE (CC.)				RIGHT PARIETAL PLEURA	LEFT PARIETAL PLEURA	RIGHT PLEURA LUNG	LEFT PLEURA LUNG	PERICARDIUM	SPLEEN	LIVER	RIGHT KIDNEY	LEFT KIDNEY
			Right pleural	Left pleural	Pericardial	Peritoneal									
G3	0.6 No. 3†	Died 15	15.0	13.0	0	0	++	−	++	+	++	−	+	−	−
G4	1.0 No. 3	Died 7	0	0	0	0	++	+	++	++	++	++	++	−	−
G5	1.5 No. 3	Died 14	2.0	2.0	0	0	+	+	++	+	+	+	+	−	−
G6	1.8 No. 3	Died 17	15.0	0	3.0	2.0	++	+	++	+	++	+	+	−	−
G7	2.0 No. 3	Died 16	0	0	0	0	++	−	+	+	++	+	−	−	−
G1	1.0 No. 5	Killed 21	0	0	0	0	++	−	++	−	−	−	−	−	−
G2	1.0 No. 5	Died 20	0.5	0	0	0	+	+	+	+	+	−	−	−	−
G9	1.0 No. 5	Died 56	1.0	1.0	0	0	++	++	++	++	++	+	+	−	−
G10	1.0 No. 5	Died 56	5.0	4.0	0	0	++	+	++	+	+	+	+	−	−
G11	1.0 No. 5	Died 51	0.5	0.5	0	0	+	+	+	+	+	+	+	−	−
Z5	1.0 No. 10	Killed 3	1.0	1.0	0	1.0	++	+	++	+	+	−	−	−	−
Z6	1.0 No. 10	Killed 7	16.0	8.0	0	3.0	++	++	++	+	+	−	−	−	−
Z7	1.0 No. 10	Killed 19	10.0	3.0	0	0	++	++	++	+	++	+	+	−	−
Z8	1.0 No. 10	Died 11	7.0	7.0	0.5	1.0	+	+	+	+	+	+	+	−	−
Z9	1.0 No. 10	Killed 13	2.0	1.5	0	0	+	+	+	+	+	+	−	−	−
Z10	1.0 No. 10	Died 12	6.0	6.0	1.0	0	++	−	++	++	−	+	−	−	−
Z11	1.0 No. 10	Died 10	18.0	13.0	0	4.0	++	+	++	+	−	+	−	−	−
Z12	1.0 No. 10	Died 12	4.0	6.0	0	0	+	+	+	+	+	+	+	−	−
Z13	1.0 No. 10	Died 14	5.0	3.0	0.5	4.0	++	+	++	−	−	−	−	−	−
Z14	1.0 No. 10	Died 13	1.0	1.0	0.5		++	−	++	−	−	+	−	−	−
D1	1.0 No. 8	Died 8	0.2	0.2	0	2.5	++	−	++	+	−	+	−	−	−
D2	1.0 No. 4	Died 16	3.5	3.5	0	4.0	++	+	++	+	+	+	−	−	−
D3	1.0 No. 2	Died 19	1.5	1.5	0	0	+	+	+	+	+	+	−	−	−

* Animals weighed 260 to 420 grams.

† Means 0.6 cc. of suspension corresponding in density to tube No. 3 of nephelometer.

The results observed with two strains of human tubercle bacilli (table 2) were closely similar. Pleuritis was probably not produced in as many animals, but the incidence of lung infections and infections of the spleen and liver was about the same as observed with bovine bacilli.

2. Pleural infections of rabbits with bovine and human tubercle bacilli. These results are summarized in tables 3 and 4.

The bovine bacilli did not produce pleuritis and lung lesions in as high a percentage of animals or of as severe a character as were observed

among the guinea pigs. The liver and spleen were likewise not involved in as high a percentage of animals as occurred among the guinea pigs but, curiously, kidney lesions were more frequent.

TABLE 2

*The results of injecting human tubercle bacilli (two strains) into the right pleural cavities of guinea pigs**

NUMBER	DOSE OF BACILLARY SUSPENSION (CC.)	DURATION (DAYS)	EXUDATE (CC.)				RIGHT PARIETAL PLEURA	LEFT PARIETAL PLEURA	RIGHT PLEURA LUNG	LEFT PLEURA LUNG	PERICARDIUM	SPLEEN	LIVER	RIGHT KIDNEY	LEFT KIDNEY
			Right pleural	Left pleural	Pericardial	Peritoneal									
D4	1 No. 8†	Died 22	0	1.0	0	0	++	−	++	−	−	−	−	−	−
D5	1 No. 4	Died 22	1.0	0	0	0	+	+	++	+	+	+	+	−	−
D6	1 No. 2	Died 25	1.0	0.5	0	0	++	+	++	+	+	+	−	−	−
D7	1 No. 8	Killed 26	0	0	0	0	++	−	++	+	−	−	−	−	−
D8	1 No. 4	Killed 26	0	0	0	0	−	−	+	+	+	+	+	−	−
D9	1 No. 2	Killed 26	0	0	0	0	−	−	+	+	+	+	−	−	−

* Animals weighed 280 to 410 grams.

† Suspension of bacilli corresponded in density to tube No. 8 of nephelometer.

The human bacilli produced fairly well marked pleuritis and lung tuberculosis on the right side and only occasionally involved the left side and the spleen. The well known susceptibility of the rabbit to bovine tubercle bacilli as compared with human strains was brought out quite clearly in these experiments.

3. Pleural infections of dogs with bovine and human tubercle bacilli. Bovine tubercle bacilli proved more virulent than human strains. With the former, well marked tuberculosis of both pleurae and lungs were produced with involvement of the pericardium and mediastinal nodes. Metastasis also occurred to the spleen and kidneys (table 5).

The human strains produced tuberculosis confined to the side of injection (right). Tubercles were generally scattered profusely over the parietal pleura, and the lung and visceral pleura showed enormous numbers of miliary lesions with large amounts of pleural exudate. The left lung and pleura were free from tubercles upon naked eye inspection and microscopic examination, although fluid was generally found in the left pleural sac, being derived in large part from the right side. Metastases to the abdominal organs did not occur in any of our animals (table 5.).

4. Pleural infections of rats with bovine and human tubercle bacilli. Albino rats weighing from 100 to 280 grams were employed. Bovine bacilli injected into the right pleural cavity almost invariably produced

TABLE 3

*The results of injecting bovine bacilli into the right pleural cavities of rabbits**

NUMBER	DOSE (CC.)	DURATION (DAYS)	EXUDATES (CC.)				RIGHT PARIETAL PLEURA	LEFT PARIETAL PLEURA	RIGHT PLEURA LUNG	LEFT PLEURA LUNG	PERICARDIUM	SPLEEN	LIVER	RIGHT KIDNEY	LEFT KIDNEY
			Right pleural	Left pleural	Pericardial	Peritoneal									
R1	2 No. 5	Killed 5	0	4.0	1.0	5.0	++	+	++	+	+	+	−	−	−
R2	2 No. 5	Died 14	2.0	0	0	0	++	−	+	−	+	−	−	−	−
R3	4 No. 3	Killed 28	2.0	2.0	1.0	40.0	++	−	++	−	+	−	−	−	−
R4	4 No. 3	Died 15	0	0	0	0	+	−	+	+	−	−	−	−	−
R5	4 No. 3	Killed 28	0	0	1.0	3.0	++	−	+	+	−	−	−	−	−
R6	4 No. 3	Killed 28	0	0	1.0	3.0	+	−	++	+	+	+	−	−	−
R7	2.5 No. 5	Died 28	0	0	0	0	+	−	++	−	−	−	−	−	−
R8	2 No. 5	Killed 35	0	0	1.0	3.0	+	+	++	+	+	+	+	−	−
R9	5 No. 5	Killed 29	10.0	10.0	0	4.0	+	+	++	+	+	+	−	−	−
R10	5 No. 5	Died 31	20.0	1.0	0	0	+	+	++	+	+	+	−	+	−
R11	5 No. 5	Killed 29	2.0	0	0	3.0	+	+	+	+	+	−	−	−	−
1A	2 No. 8	Died 22	0.5	0.5	1.0	0	+	−	++	+	+	−	−	+	+
2A	2 No. 4	Died 25	0.5	0.5	0	0	−	−	++	+	+	+	+	+	+
3A	2 No. 2	Killed 26	0	0	0	0	−	−	+	+	−	−	−	−	−

* Animals weighed 1800 to 2300 grams.

TABLE 4

*The results of injecting human tubercle bacilli (two strains) into the right pleural cavities of rabbits**

NUMBER	DOSE (CC.)	DURATION (DAYS)	EXUDATES (CC.				RIGHT PARIETAL PLEURA	LEFT PARIETAL PLEURA	RIGHT PLEURA LUNG	LEFT PLEURA LUNG	PERICARDIUM	SPLEEN	LIVER	RIGHT KIDNEY	LEFT KIDNEY
			Right pleural	Left pleural	Pericardial	Peritoneal									
4A	2 No. 8	Killed 27	0	0	0.5	3.0	++	−	++	+	+	−	−	−	−
5A	2 No. 4	Killed 28	0.5	0.5	0	0	++	−	++	−	−	−	−	−	−
6A	2 No. 2	Killed 28	1.0	0	0	5.0	+	−	+	−	+	−	−	−	−
7A	2 No. 8	Killed 28	0	0	0	0	−	−	−	−	−	−	−	−	−
8A	2 No. 4	Killed 28	0	0	1.0	3.0	++	−	++	−	−	−	−	−	−
9A	2 No. 2	Killed 28	0.5	0.5	1.0	3.0	++	−	++	+	−	+	−	−	−
1	2 No. 8	Killed 28	0	0	0	0	++	−	++	−	+	−	−	−	−
2	2 No. 8	4 days	0	0	0	0	−	−	−	−	−	−	−	−	−
3	1 No. 8	Killed 28	0	0	0	0	++	+	++	++	+	−	−	−	−
4	1 No. 8	Killed 28	0	0	0	0	++	−	++	−	−	−	−	−	−
5	0.5 No. 8	Died 21	0	0	0	0	++	−	++	−	−	−	−	−	−
6	0.5 No. 8	Killed 28	0	0	0	0	+	−	+	−	−	−	−	−	−

* Animals weighed from 2000 to 2400 grams.

well defined lesions of the parietal and visceral pleurae and lung with extension to the mediastinal nodes and pericardium, but with involvement of the left side in only about 10 per cent. of animals. Metastases to the spleen, liver and kidneys were not observed, although it may be mentioned here that all animals were examined within a period of twenty-eight days from the time of infection (table 6).

TABLE 5

*The results of injecting human and bovine tubercle bacilli into the right pleural cavities of dogs**

NUMBER	STRAIN	DOSE (CC.)	DURATION	PLEURAL EXUDATES		RIGHT PARIETAL PLEURA	LEFT PARIETAL PLEURA	RIGHT PLEURA LUNG	LEFT PLEURA LUNG	PERICARDIUM	BRONCHIAL NODES	DIAPHRAGM	SPLEEN	LIVER	RIGHT KIDNEY	LEFT KIDNEY
				Right	Left											
				cc.	cc.											
1	Bovine	5 (No. 8)	4 weeks†	100	60	+	+	+	+	+	+	+	+	−	+	+
2	Bovine	2 (No. 8)	4 weeks	35	30	++	++	++	++	+	+	−	−	−	+	
3	Bovine	1 (No. 8)	4 weeks	15	20	++	++	++	++	+	+	+	−	−	−	−
4	Human	5 (No. 8)	4 weeks	180	170	++	−	++	−	−	−	−	−	−	−	−
5	Human	2 (No. 8)	4 weeks	225	130	++	−	++	−	−	−	−	−	−	−	−
6	Human	1 (No. 8)	14 days	0	0	−	−	++	−	−	−	−	−	−	−	−

* Animals weighed 8.5 to 10 kilos.

† Nos. 1, 2, 3, 4 and 5 living at end of 4 weeks.

Human bacilli were less virulent and the lesions were confined to the side of injection with involvement of the pericardium and mediastinal nodes in the majority of animals. None, however, showed involvement of the left side or of the spleen, liver and kidneys (table 6).

The lesions were best developed in animals weighing from 100 to 150 grams.

EXPERIMENTAL TUBERCULOUS PLEURITIS AND PNEUMONITIS

The distribution, type and severity of the experimental lesions varied considerably among the different species of animals and to some extent among the animals of the same species. *As a general rule the best developed lesions of the right pleura and lung were observed among animals having a certain degree of natural immunity to tubercle bacilli,* such as the rabbit to human bacilli, the dog and rat to human and bovine bacilli.

The lesions of the parietal pleura varied from a few tubercles around the site of injection to widespread miliary tuberculosis. Occasionally a large tubercle or mass of tubercles was found at the apex, with adhesions, or at the diaphragmatic angle. In a few instances tubercles developed in the thoracic muscles.

The lung lesions were of varying types and severity. In some, well marked pleuritis was observed, with innumerable miliary tubercles, especially in the lungs of dogs and rats. In other animals, especially guinea pigs infected with both human and bovine strains, and rab-

TABLE 6

*The results of injecting human and bovine tubercle bacilli into the right pleural cavities of white rats**

NUMBER	STRAIN	DOSE† (CC.)	RIGHT PARIETAL PLEURA	LEFT PARIETAL PLEURA	RIGHT LUNG PLEURA	LEFT LUNG PLEURA	PERICARDIUM	DIAPHRAGM PLEURA	LIVER	SPLEEN	RIGHT KIDNEY	LEFT KIDNEY
1	Bovine	1.0 (No. 8)	++	−	++	−	+	+	−	−	−	−
2	Bovine	1.0 (No. 8)	+	−	+	−	−	+	−	−	−	−
3	Bovine	1.0 (No. 8)	+	−	+	−	−	+	−	−	−	−
4	Bovine	0.5 (No. 8)	++	−	++	−	−	+	−	−	−	−
5	Bovine	0.5 (No. 8)	++	−	++	−	−	+	−	−	−	−
6	Bovine	0.5 (No. 8)	−	−	++	−	+	−	−	−	−	−
7	Bovine	0.1 (No. 8)	+	−	−	−	−	+	−	−	−	−
8	Bovine	0.1 (No. 8)	+	+	+	+	+	++	−	−	−	−
9	Bovine	0.1 (No. 8)	++	−	+	−	−	+	−	−	−	−
10	Human	1.0 (No. 8)	++	−	+	−	+	+	−	−	−	−
11	Human	1.0 (No. 8)	−	−	−	−	−	−	−	−	−	−
12	Human	1.0 (No. 8)	−	−	−	−	−	−	−	−	−	−
13	Human	0.5 (No. 8)	+	−	+	−	+	+	−	−	−	−
14	Human	0.5 (No. 8)	+	−	+	−	−	+	−	−	−	−
15	Human	0.5 (No. 8)	+	−	+	−	+	+	−	−	−	−
16	Human	0.1 (No. 8)	−	−	−	−	−	−	−	−	−	−
17	Human	0.1 (No. 8)	−	−	−	−	+	+	−	−	−	−
18	Human	0.1 (No. 8)	−	−	−	−	−	+	−	−	−	−

* Animals weighed 140 to 285 grams.

† All animals living at the end of 4 weeks when examinations were made.

bits with bovine bacilli, the visceral pleura showed but few tubercles, whereas the lungs were riddled with them. Numerous instances were observed of tubercles located in the substance of the lung some distance beneath an apparently normal and intact pleura, the bacilli being transmitted by vascular or lymphatic channels.

In the majority of lungs the tubercles were circumscribed and typical; in others the changes were diffuse, producing acute tuberculous pneumonia.

The lesions of the left lung and pleura were similar; almost invariably, however, the disease was best developed in the lung with fewer lesions of the visceral and parietal pleurae.

Involvement of the mediastinal nodes was found in practically all animals, the lesions varying from microscopic tubercles to large caseous masses. The pericardium usually showed the presence of tubercles, but tubercles of the epicardium and heart were not found, although the pericardial sac frequently contained an excess of fluid.

TABLE 7

The cytology and albumin content of tuberculous pleural exudates

NUMBER	DURATION (DAYS)	RIGHT PLEURAL EXUDATES				LEFT PLEURAL EXUDATES				TUBERCLE BACILLI
		Small lymphocytes	Polymorphonuclears	Endothelials	Albumin (approximate per cent)	Small lymphocytes	Polymorphonuclears	Endothelials	Albumin (approximate per cent)	
Z6	8	58	40	2	3.1	89	18	2	3.4	+
Z11	12	95	5	0	3.6	92	7	1	2.9	+
Z8	13	77	15	8	3.8	84	15	1		+
Z10	14	81	15	4	3.0				3.0	+
Z12	14	97	3	0	3.9	90	10		3.0	+
G3	16	50	39	11	3.1	65	25	10		+
Z13	16	91	7	2						+
G6	18	65	35		2.4					+
Z7	21	82	8	10					3.0	+
G10	27	85	14	1	3.7	73	23	4		+
R3	30	68	23	9						+
R9	31	86	13	1	4.5	83	17	0		+
R11	32	80	8	12						+

The pleural portions of the diaphragm were frequently involved on both sides; tubercles on the abdominal portions were, however, encountered in only a few instances.

The lesions of the spleen, liver and kidneys presented the usual appearances; not infrequently these organs were free from macroscopic tubercles which were found upon histological examination. Cloudy swelling, passive hyperemia and other well known changes accompanying tubercle formation were observed.

The inflammatory exudates presented the usual cytological and chemical features of tuberculous exudates. The chief difference from exudates observed in human pleuritis consisted in the *very large numbers of tubercle bacilli to be found.* Only exceptionally there was none to be found in ordinary smears of the sediment obtained by centrifugation.

These exudates were of the usual straw-colored, serous fluid, and could be obtained in many instances during the life time of the experimental animal, and particularly from the dogs and guinea pigs. Sometimes these fluids contained considerable blood.

As is true of exudates occurring in human tuberculosis, small lymphocytes usually predominated (table 7).

DISCUSSION

As before stated, our aim was to produce, as far as possible, localized tuberculous infections. The pleural cavity would appear to be ideal for this purpose, because the medicament may be brought into intimate contact with the lesions and the injections of the latter are given with great ease. Mere tuberculocidial activity on the part of the medicament

TABLE 8

Percentage of lesions produced by injections of bovine and human tubercle bacilli into the right pleural cavities of animals

ANIMAL	STRAIN	RIGHT PARIETAL PLEURA	LEFT PARIETAL PLEURA	RIGHT PLEURA AND LUNG	LEFT PLEURA AND LUNG	PERICARDIUM	SPLEEN	LIVER	RIGHT KIDNEY	LEFT KIDNEY
Guinea pig	Bovine	100	74	100	87	74	70	43		
Guinea pig	Human	66	33	100	83	66	66	33		
Rabbit	Bovine	85	35	100	78	71	43	14	21	14
Rabbit	Human	83	8	83	25	33	8			
Dog	Bovine	100	100	100	100	100	33		66	33
Dog	Human	66		100						
Rat	Bovine	89	10	89	10	33				
Rat	Human	44		44		33				

under study may not, however, influence the lesions if treatment is instituted after the disease is well advanced, unless the medicament can penetrate the new inflammatory exudate and tissue of the tubercles. The earlier treatment is begun, however, the less need be this penetrating property of the medicament, and in the chemotherapeutic experiments being conducted by one of us (K.), treatment is begun at varying intervals after infection.

These experiments have failed to disclose a method of infection in which the disease is confined strictly to the parietal and visceral pleurae; the lung and bronchial nodes on the same side are invariably involved. But lesions confined to the pleura and lung of the same side in which the bacilli are inoculated are still ideal for chemotherapeutic investigations. Table 8 shows a summary of the distribution of lesions observed in these experiments, and indicates that from the standpoint of production of localized lesions, best results are observed with the following combinations named in order of preference (table 8):

1. Rats infected with bovine bacilli.
2. Dogs infected with human bacilli.
3. Rats infected with human bacilli.
4. Dogs infected with bovine bacilli.
5. Rabbits infected with human bacilli.

Guinea pigs are unsuitable; susceptibility to both human and bovine bacilli is too great and the lesions are consequently too widespread.

The proper procedure is to select an animal having a well defined natural immunity to tuberculosis and infect the right pleural cavity with sufficient numbers of tubercle bacilli of slight or moderate virulence; highly virulent strains are too invasive and should not be employed.

The amount of culture to be employed varies with different strains and must be determined by preliminary experiments. Our work is being conducted with strain H of bovine bacilli furnished by Dr. Fred Boerner of the Pennsylvania State Livestock Laboratory, Philadelphia, Pa. As shown in the charts, our doses have been large, probably unnecessarily large. But in chemotherapeutic experiments it is necessary to employ doses of culture yielding 100 per cent. "takes" in the controls, in order to avoid errors and misinterpretation of results. At this time we do not know the minimal dose to employ, as only prolonged experience can yield this information. It is necessary, however, to use animals of approximately the same age and weight in order to secure uniform results. Owing to the small size and cheapness of the white rat, we believe this to be the animal of choice, inasmuch as large numbers may be used, as is necessary in chemotherapeutic research.

SUMMARY

1. For chemotherapeutic investigations in bacterial infections, localized are better than generalized infections for the study of medicaments possessing but a slight margin between the toxic and curative doses.

2. For chemotherapeutic investigations in tuberculosis, it is recommended that experimental tuberculous pleuritis and pneumonitis be employed as a lesion offering more hope for successful therapy than generalized infections.

3. For the production of experimental tuberculous pleuritis, the animal should be of a species possessing some natural immunity, in order to reduce invasiveness of the bacilli and the development of lesions in distant organs; the cultures should be of moderate rather than high virulence.

4. Experiments with guinea pigs, rabbits, dogs and white rats, employing human and bovine strains of tubercle bacilli, have shown that the best lesions largely confined to the side of injection were produced in rats by bovine bacilli (strain H) and in dogs by human bacilli.

We are indebted to Mr. Louis Borow for aid in conducting some of these experiments.

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A STUDY OF THE PRECIPITIN AND COMPLEMENT FIXATION REACTIONS WITH TUBERCULOUS EXUDATES WITH SPECIAL REFERENCE TO TUBERCULOUS PLEURITIS*

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This investigation was undertaken for the purpose of determining whether the immunological reactions of precipitation and complement fixation occur with pleural exudates of tuberculous origin, as additional means and aids for the differential diagnosis of pleural effusions. The necessity for diagnostic aids of this character has been impressed upon the writer since 1913, when he found large numbers of Japanese soldiers and many civilians in Mukden, South Manchuria, with mild pleuritis and exudates of unknown origin. At least 52 per cent. of a group of 42 of these individuals yielded negative v.Pirquet tuberculin skin reactions; cultures of the fluids from 21 were negative and tubercle bacilli were not formed by smear methods. It is commonly believed that these "light pleurisies"[1] are of tuberculous origin but this has not been proven and the exact etiology is unknown.

Since the demonstration of tubercle bacilli in pleural fluids of tuberculous pleuritis is frequently impossible and no other exact laboratory test being available, studies have been made with the precipitin and complement fixation reactions, and the results are summarized in this article.

MATERIALS AND METHODS

Pleural fluids have been obtained from patients in Philadelphia with tuberculous pleuritis, pneumococcus pleuritis, cardiac insufficiency with pleural transudates and from one case of carcinoma of the pleura with effusion; also from a large number of guinea pigs and rabbits with experimental tuberculous pleuritis previously described by Kolmer and the writer.[2] The latter were particularly useful in this study because means were afforded for determining the approximate time required for the presence of complement fixing antibodies in pleural exudates, which was not possible in the human cases of tuberculous pleuritis because of the indefinite histories in relation to the probable duration of infection.

* From the Dermatological Research Institute of Philadelphia and the Pathological Laboratories of the Graduate School of Medicine of the University of Pennsylvania.

In the majority of instances of experimental tuberculous pleuritis in the guinea pigs, effusions were found in both right and left pleural sacs and frequently in the pericardial and peritoneal spaces; precipitin and complement fixation tests were conducted with all fluids.

Precipitin tests were conducted with pleural fluids as preciptinogens and tuberculosis immune goat and calf sera, kindly furnished by Mr. Glenn, Dr. Paul Lewis and Dr. Aronson. These tests wre conducted in the classical manner by laying clear pleural fluids over 0.1 cc. of immune serum in test tubes of appropriate size and reading the results after one and again after twenty-four hours.

The complement fixation tests were conducted according to the technic of Dr. Kolmer's new method for bacterial complement fixation tests.[3] Each fluid was first titrated for its anticomplementary activity and employed in 1/3, 1/6, 1/12, 1/24, 1/48, etc., of this amount with 1/3 the anticomplementary unit of an antigen of human tubercle bacilli prepared after a method described by Petroff.[4] The primary incubation was eighteen hours in a refrigerator at 6—8° C. plus ten minutes in a water bath at 38° C., this method having been found by Kolmer to increase greatly the sensitiveness of the tuberculosis complement fixation test over the usual method of water bath incubation for one hour. The secondary incubation was one hour in a water bath, the readings being made a few hours later and recorded after the well known scale of ++++, +++, ++, + and — reactions.

Each human and experimentally produced exudate was also studied bacteriologically, cytologically and the majority for albumin content. The results of these studies with the fluids from experimental lesions are given elsewhere;[1] with the fluids from human cases the data was employed with clinical data for establishing the diagnoses.

RESULTS

(a) *The results of precipitin and complement fixation tests with human tuberculous pleural exudates.*—These are summarized in table 1. Of the fluids from twelve cases, five or about 42 per cent. yielded positive precipitin reactions; the reactions, however, were quite weak and usually discernable only after twenty-four hours.

All of the fluids but one, however, yielded well defined complement fixation reactions (92 per cent.). As shown in this table some of the fluids were hemolytic (Nos. 5, 10, 11 and 13) so that the smaller amounts yielded positive reactions while the larger amounts produced partial or complete hemolysis. In every test the exudate controls with all amounts, antigen and hemolytic controls, yielded complete hemolysis and were satisfactory.

Table 2 summarizes the results observed with five pleural exudates of non-tuberculous origin. All yielded negative precipitin reactions; likewise all but one yielded negative complement fixation reactions. The one fluid reacting weakly positive was from a syphilitic with

TABLE 1

Results of Precipitin and Complement Fixation with Human Tuberculous Pleural Exudates.

CASE NO.	AGE (YRS.)	SEX	CLINICAL DIAGNOSIS	TUBERCLE BACILLI IN SMEARS	PRECIPITIN REACTIONS	ANTICOMPLEMENTARY UNIT CCQ.	COMPLEMENT FIXATION REACTION					
							1/3*	1/6	1/12	1/24	1/48	CONTROL
1	24	M	T. B. pleuritis	None	—	0.1	++	++	+	—	—	—
4	36	M	T. B. pleuritis	None	—	0.6	—	—	—	—	—	—
5	7	M	T. B. pleuritis	Present	—	0.6	+	+	++	+++	++++	—
6	24	F	T. B. pleuritis	None	—	0.6	++++	++++	++++	+++	++	—
7	23	M	Pleuritis (Probably T. B.)	None	—	0.6	++++	++++	++++	++++	++	—
9	31	F	T. B. pleuritis	None	+	0.1	+++	++	+	—	—	—
10	23	M	T. B. pleuritis	None	+	0.06	—	—	—	+++	+++	—
11	30	F	T. B. pleuritis	None	+	0.06	—	—	++++	++++	++++	—
12	19	M	T. B. pleuritis	Present	+	0.1	++	+	W	—	—	—
13	29	M	T. B. pleuritis	None	—	0.6	—	—	W	+	+	—
18	27	F	T. B. pleuritis	None	—	1.0	++	++	+	—	—	—
20	59	F	T. B. pleuritis	None	—	0.06	+	+	—	—	—	—

* 1/3 of the anticomplementary unit of pleural fluid, etc.

TABLE 2

Results of Precipitin and Complement Fixation Tests with Human Non Tuberculous Transudates and Exudates.

CASE NO.	AGE (YRS.)	SEX	CLINICAL DIAGNOSIS	PRECIPITIN REACTION	ANTICOMPLEMENTARY UNIT C. C.	COMPLEMENT FIXATION REACTION					
						1/3	1/6	1/12	1/24	1/48	CONTROL
2	47	F	Cardiac Insufficiency	—	0.3	—	—	—	—	—	—
3	14	M	Pneumococcus pleuritis	—	0.6	—	—	—	—	—	—
14	adult	M	Pneumococcus pleuritis	—	0.06	—	—	—	—	—	—
16	26	M	Cardiac Insufficiency*	—	0.9	+	W	—	—	—	—
17	40	F	Carcinoma of pleurae	—	0.6	—	—	—	—	—	—

* Patient a syphilitic with aortic insufficieny; blood serum gave positive Wassermann reactions. No evidences of tubercul sis at necropsy.

cardiac decomposition (No. 16); I believe that this result was due to the presence of syphilis "reagin" fixing complement with the lipoids of the tuberculous antigen (5); for this reason the antigen of tubercle bacilli should be freed of lipoids in order to remove the possibility of these cross complement fixation reactions.

(b) *The results of precipitin and complement fixation tests with pleural, pericardial and peritoneal exudates in experimental tuberculous pleuritis of guinea pigs.*—These animals were infected with injections of virulent bovine bacilli* into the right pleural sacs. Well defined pleuritis was produced in the majority of animals on both sides; in many instances tuberculous pericarditis with effusion also resulted. Tests were made with effusions developing four to twenty-seven days after infection and the results are shown in table 3.

Of eighteen exudates from the right pleural sacs, four or about 22 per cent. yielded positive precipitin reactions; eleven or about 61 per cent. yielded positive complement fixation reactions. No positive reactions were observed with fluids removed earlier than twelve days after infection; after the fifteenth day following infection, nine out of ten fluids or 90 per cent. yielded positive complement fixation reactions.

Eighteen left pleural fluids were examined; of these one or 6 per cent. yielded positive precipitin reactions but eleven or 61 per cent. yielded positive complement fixation reactions. Of nine fluids removed fifteen days or longer after infection of the right pleural cavity, eight or 88 per cent. yielded positive complement fixation reactions.

Two pericardial fluids were examined; both yielded negative precipitin reactions while one (removed eighteen days after infection) yielded strongly positive complement fixation reactions.

Five peritoneal fluids were examined; all yielded negative precipitin and complement fixation reactions. In this connection it may be stated that tubercles were not found in the peritoneum of any of these animals,[2] although present in the liver and spleen of a few.

The sera of a number of these animals were also tested and the results observed with nine are shown in table 4. All yielded negative precipitin reactions and five yielded positive complement fixation reactions. One of these animals showed very extensive bilateral pleural, pulmonary and pericardial tuberculosis. All of the sera yielding positive reactions were from animals sixteen days or longer after inoculation.

The sera of thirty control guinea pigs yielded uniformly negative complement fixation reactions.

The results observed with pleural, pericardial and peritoneal fluids from rabbits infected with intrapleural injections of tubercle bacilli, are summarized in Table 5. These animals did not show as well marked experimental lesions as the majority of guinea pigs.[2]

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* Strain H, kindly furnished by Dr. F. Boerner of the Pennsylvania State Livestock Laboratory.

Fourteen days or longer after infection the majority of these fluids yielded positive complement fixation reactions and especially the fluids from the right pleural cavities; only one fluid (right pleural cavity) yielded a positive precipitin reaction.

The sera of all animals yielded positive complement fixation reactions, but owing to the well known property of normal rabbit sera for yielding positive non-specific complement fixation reactions, little or no significance can be attached to these results. The reactions observed with the exudates, however, were specific insofar as could be determined.

DISCUSSION

These results indicate that in the exudates from tuberculosis of serous cavities, precipitins and complement fixing antibodies may be found, especially the latter when a sensitive antigen and technic are employed.

In a study of the Wassermann test with exudates and transudates in syphilis, Klauder and Kolmer[6] observed uniformly positive reactions with inflammatory exudates when the reactions with blood sera were negative. Secretions from chancres yielded positive reactions before the syphilis "reagin" could be found in the blood sera indicating a local production of the antibody responsible for the Wassermann reaction.

The results of these studies in syphilis in conjunction with those reported in this paper, indicate that specific antibodies are to be found in the exudates of localized infections at a time when they cannot be demonstrated in the blood sera, probably because of their high dilution in the latter. These exudates are readily adapted for complement fixation tests if special attention is given to the following technical steps:

1. The fluid should be centrifuged to remove the cells.

2. The fluid should be heated at 55° C. for fifteen minutes to remove complement, thermolabile hemolysin, thermolabile antilysin if present and the substance responsible for the proteotropic reaction. For these purposes longer periods of heating are unnecessary and result in a useless destruction of antibody, as shown by the studies of Kolmer and his associates in syphilis.

3. The fluid should be titrated for anticomplementary activity as they vary greatly in this property and cannot be employed in a fixed amount; similar findings were reported by Klauder and Kolmer in their study of exudates and transudates in syphilis.

Since some fluids are markedly hemolytic it is advisable to use varying amounts beginning with 1/2 or 1/3 the anticomplementary unit as employed in this study. The nature of the hemolytic substance sometimes found in these fluids has not yet been determined.

4. The antigen and complement fixation technic should be as sensitive as consistent with specificity. As previously stated, the antigen employed for tests with human fluids should be free of lipoids as prepared by Kolmer in order to avoid cross complement fixation tests with tuberculous exudates from syphilitic individuals.

TABLE 3

Results of Percipitin and Complement Fixation Tests with Pleural, Pericardial and Peritoneal Exudates in Experimental Tuberculous Pleuritis of Guinea Pigs.

ANIMAL	DAYS SINCE INOCULATION	FLUID TESTED	TUBERCLE BACILLI	PRECIPITIN REACTION	ANTICOMPLEMENTARY UNIT C. C.	COMPLEMENT FIXATION REACTION							
						1/3	1/6	1/12	1/24	1/48	1/96	1/192	CONTROL
Z 5	4	Right Pleural	—	—	0.3	—	—	—	—	—	—	—	—
		Left Pleural	—	—	0.3	—	—	—	—	—	—	—	—
		Peritoneal	—	—	0.3	—	—	—	—	—	—	—	—
Z 6	8	Right Pleural	—	—	0.3	—	—	—	—	—	—	—	—
		Left Pleural	—	—	0.3	—	—	—	—	—	—	—	—
		Peritoneal	—	—	0.3	—	—	—	—	—	—	—	—
M 14	10	Right Pleural	—	—	0.3	—	—	—	—	—	—	—	—
		Left Pleural	—	—	0.3	—	—	—	—	—	—	—	—
M 15	12	Right Pleural	+	—	0.3	+	—	—	—	—	—	—	—
		Left Pleural	—	—	0.3	+	—	—	—	—	—	—	—
Z 11	12	Right Pleural	—	—	0.9	—	—	—	—	—	—	—	—
		Left Pleural	—	—	0.9	—	—	—	—	—	—	—	—
		Peritoneal	—	—	0.05	—	—	—	—	—	—	—	—
M 13	13	Left Pleural	+	—	0.3	++	+	—	—	—	—	—	—
Z 8	13	Right Pleural	—	—	0.5	—	—	—	—	—	—	—	—
		Left Pleural	—	—	0.6	W	—	—	—	—	—	—	—
		Pericardial	—	—	0.2	—	—	—	—	—	—	—	—

		Peritoneal	—	—	0.05	—	—	—	—	—	—	—	—
Z 10	14	Right Pleural	+	+	0.9	—	—	—	—	—	—	—	—
		Left Pleural	—	—	0.9	—	—	—	—	—	—	—	—
Z 12	14	Right Pleural	+	W	0.3	+++	++	+	—	—	—	—	—
		Left Pleural	+	—	0.3	+++	++	+	—	—	—	—	—
Z 9	15	Right Pleural	—	—	0.06	+++	++	—	—	—	—	—	—
		Left Pleural	—	—	0.3	+++	++	—	—	—	—	—	—
Z 14	15	Right Pleural	—	—	0.3	—	—	—	—	—	—	—	—
		Left Pleural	—	—	0.3	—	—	—	—	—	—	—	—
Z 13	16	Right Pleural	—	—	0.9	++	+	—	—	—	—	—	—
		Left Pleural	—	—	0.6	++	++	—	—	—	—	—	—
G 3	16	Right Pleural	—	—	1.0	++++	++++	++++	++++	++++	+++	+	—
		Left Pleural	—	—	1.0	++++	++++	++++	++++	++++	+++	+	—
G 6	18	Right Pleural	—	+	1.0	++++	++++	++++	++++	++++	+++	++	—
		Pericardial	—	—	1.0	++++	++++	+++	+	—	—	—	—
		Peritoneal	—	—	0.05	—	—	—	—	—	—	—	—
Z 7	21	Right Pleural	—	—	0.3	++	+	+	—	—	—	—	—
		Left Pleural	—	—	0.3	++	+	—	—	—	—	—	—
G 10	27	Right Pleural	+	—	0.3	++	+	—	—	—	—	—	—
		Left Pleural	—	—	0.5	++	+	—	—	—	—	—	—
D 3	19	Right Pleural	—	—	0.2	+++	+++	++	+	—	—	—	—
		Left Pleural	—	—	0.2	+++	+++	++	+	—	—	—	—
D 4	22	Left Pleural	—	—	0.3	++++	+++	++	++	+	—	—	—
D 5	22	Right Pleural	—	—	0.1	+++	+++	+++	++	+	—	—	—
D 6	25	Right Pleural	+	+	0.3	++++	++++	+++	++	+	—	—	—
		Left Pleural	+	+	0.3	++++	++++	+++	++	+	—	—	—

5. It is advisable to employ a control on each amount of exudate tested in order to avoid error with fluids which are hemolytic in large amounts but anticomplementary in smaller amounts.

With these technical considerations it is believed that the complement fixation test will prove of value in the diagnostic tuberculous pleuritis of fifteen days or longer duration.

CONCLUSIONS

1. Of a series of twelve tuberculous pleural exudates, 42 per cent. yielded weakly positive precipitin and 92 per cent. well defined positive complement fixation reactions.

2. Human pleural exudates and transudates of non-tuberculous origin yielded uniformly negative precipitin and tuberculosis complement fixation reactions. In syphilis, however, positive reactions may occur due to the presence of the "reagin" in the exudate unless precautions are taken to prove the lipoids from the antigen of tubercle bacilli.

3. With the pleural exudates secured fifteen days or longer after experimental tuberculous pleuritis in guinea pigs, 8 per cent. yielded weakly positive precipitin reactions and 89 per cent. strongly positive complement fixation reactions.

4. In experimental tuberculous pleuritis and pericarditis of guinea pigs and rabbits, precipitins and complement fixing antibodies are not usually found earlier than twelve days after infection.

5. These results indicate that in the exudates of tuberculous pleuritis, precipitins and especially complement fixing antibodies, are found in a large percentage and that a sensitive complement fixation test with special attention to certain technical features, may prove a valuable practical aid to diagnosis.

I beg to express my gratitude to Professor Kolmer for his guidance and directions in the technic of this investigation.

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TABLE 4

Results of Precipitin and Complement Fixation Tests with the Blood Sera of Guinea Pigs with Experimental Tuberculous Pleuritis.

ANIMAL	DAYS SINCE INOCULATION	PRECIPITIN REACTIONS	COMPLEMENT FIXATION REACTIONS					
			0.1	0.05	0.025	0.0125	0.006	CONTROL
Z 5	4	—	—	—	—	—	—	—
Z 6	8	—	—	—	—	—	—	—
M 6	8	—	—	—	—	—	—	—
Z 9	15	—	—	—	—	—	—	—
G 3	16	—	++++	++++	++++	+++	++	—
Z 7	21	—	++	+	W	—	—	—
D 7	26	—	++	+	+	—	—	—
D 8	26	—	+	W	—	—	—	—
D 9	26	—	+++	++	++	+	—	—

TABLE 5

Results of Precipitin and Complement Fixation Tests with Pleural, Pericardial and Peritoneal Exudates in Experimental Tuberculous Pleuritis of Rabbits

ANIMAL	DAYS SINCE INOCULATION	EXUDATE	TUBERCLE BACILLI	PRECIPITIN REACTION	ANTICOMPLEMENTARY UNIT C. C.	COMPLEMENT FIXATION REACTION					
						1/3	1/6	1/12	1/24	1/48	CONTROL
R 2	14	Right Pleural	+	++	0.05	++++	+++	+	+	+	—
R 3	30	Right Pleural	—	—	0.3	+	+	—	—	—	—
		Left Pleural	—	-	0.3	+	+	—	—	—	—
		Pericardial	—	—	0.3	+	—	—	—	—	—
		Peritoneal	—	—	0.6	++	—	—	—	—	—
R 9	31	Right Pleural	—	—	0.6	+++	+++	++	+	—	—
		Left Pleural	—	—	0.6	+++	+++	+++	+	—	—
		Peritoneal	—	—	0.6	++	++	+	—	—	—
R 11	32	Right Pleural	—	—	0.3	+++	+++	++	+	—	—
		Peritoneal	0	0	0.03	++	—	—	—	—	—
R 1	35	Left Pleural	—	—	0.3	++++	++++	++++	++++	++	—
		Pericardial	—	—	0.3	++++	++++	+++	++	—	—
		Peritoneal	—	—	0.3	++++	++++	++++	++++	++++	—
D 1	22	Pericardial	—	—	0.3	++++	++++	+++	++	+	—
D 2	25	Pericardial	—	—	0.3	++++	++++	+++	++	+	—
D 4	27	Pericardial	—	—	0.15	+	—	—	—	—	—
D 5	27	Left pl. fl.	—	—	0.15	++	+	—	—	—	—
D 8	28	Pericardial	—	—	0.3	+++	++	+	W	—	—
		Peritoneal	—	—	0.15	++	++	—	—	—	—
D 9	28	Pericardial	—	—	0.3	+++	++	+	—	—	—
		Peritoneal	—	—	0.15	+++	++	+	—	—	—

* All of the sera of these rabbits yielded positive tuberculosis complement. Complement fixation reactions may have been non specific.

THE ABSORPTION OF CALCIUM AND ITS DEPOSITION IN THE TISSUES OF EXPERIMENTAL TUBERCULOSIS*

By Mary E. Maver, B.S., and H. Gideon Wells, M.D.

Chicago

Although there is a large literature on the treatment of human tuberculosis with calcium salts of one sort or another, yet there is very little of it that will stand scientific criticism. The hypothesis of a demineralization in tuberculosis, so warmly supported by numerous clinicians, especially in France, does not find corroboration in the few investigations in which adequate methods and controls have been used. Furthermore there is little if any evidence that administration of calcium salts by mouth to persons or animals with normal amounts of calcium in their blood and tissues, causes any demonstrable increase in blood or tissue calcium. Normally the blood carries about as much calcium as it can keep in solution, and hence it is not to be expected that feeding calcium will raise the amount dissolved in the blood. Neither is there any reason to believe that calcification of tubercles is a cause rather than a sequel of healing of the lesions, or that this process of calcification is hastened by oral administration of calcium salts. Nevertheless there are many enthusiastic advocates of the value of calcium in tuberculosis therapy, and there is a world-wide tradition that workers in atmospheres charged with calcium dust are resistant to tuberculosis. It has therefore seemed worth while to study on an experimental basis the influence of calcium feeding on the calcium metabolism and calcium content of experimental animals, and its influence on the course and chemistry of experimental tuberculous lesions, since such studies seem not to have been made in any adequate way. Not all these studies have been completed, and we present today only certain completed observations, without further discussion of the existing literature.

Chemical analyses have been made of the tissues of normal guinea pigs fed on the usual laboratory diet of hay, oats and carrots; of normal guinea pigs on the same diet with the addition of 0.1880 gm. calcium lactate six days a week for several weeks; of guinea pigs infected with tuberculosis and given calcium lactate, and of guinea pigs similarly infected but not given calcium lactate.

The results may be summarized briefly in the following table:

* From the Otho S. A. Sprague Memorial Institute and the Pathological Laboratory, University of Chicago.

General Summary of Acutely Tuberculous Pigs

	% Calcium	Milligrams calcium in 100 grams dried tissue						
	Bones	Heart	Kidneys	Muscle	Liver	Lymph Glands	Lungs	Spleen
Averages for all (20) calcium fed guinea pigs.	23.32	71.10	54.25	34.69	55.86	176.05	52.06	78.18
Min. — Max.	15.27-27.96	40.5-160.	6.0-92.0	10.7-88	16.0-317.8	32.0-1298.0	27.0-91.3	22.1-278
Averages for (9) calcium fed tuberculous guinea pigs. Min. — Max.	23.78	78.3	55.02	46.17	64.15	257.8	54.5	106.78
	15.27-26.36	44.0-160.0	6.0-81.6	14.0-88.0	16.0-317.8	32.0-1298.0	27.0-91.3	22.1-278
Averages for (11) calcium fed guinea pigs, not tuberculous. Min. — Max.	23.85	64.57	53.56	24.33	36.44	94.3	49.6	52.43
	18.67-27.96	40.5-103.0	26.8-92.0	10.7-48.2	16.0-317.8	32.0-1298.0	27.0-91.3	22.1-278
Averages for (10) tuberculous guinea pigs, not fed calcium. Min.—Max.	24.89	65.41	64.69	38.15	46.8	100.58	59.06	128.6
	23.16-26.90	44.9-113.2	26.4-85.6	9.8-64.4	7.4-160.0	19.0-181.0	29.2-129.7	3.5-673.0
Averages for (12) guinea pigs not fed calcium, and not tuberculous.	23.09	51.15	41.40	44.6	38.00	52.8	48.5	49.5
Min. — Max.	20.1-26.67	30.8-71.0	16.0-65.0	35.0-57.0	26.0-67.0	25.0-71.0	30.0-73.0	20.0-80.0

Analysis of the tissues of 12 *normal* guinea pigs fed on the ordinary laboratory diet without addition of calcium, shows that although there are marked individual variations in the calcium content of the same organ in different animals, and between the calcium content of different organs of the same animal, yet when the averages are obtained the proportion of calcium in each tissue is nearly the same, varying between 38.00 mg. per 100 gram dry substance in the liver and 52.8 mg. in the lymph glands.* If we estimate the average dry weight of the tissues as 25 per cent. of the total moist weight, we find that the proportion of calcium in the tissues is from 10 to 14 mg. per 100 gm. moist weight, or quite the same proportion as in the whole blood of the animal.

Analysis of the tissues of eleven *normal* pigs fed calcium shows, on the whole, little difference from the quantities found in the animals that had received only the usual food. The chief difference to be seen is an occasional exceptionally high result in the calcium fed pigs which brings up the average slightly above that seen in the control animals. If we average the calcium figures for the seven tissues analysed, excluding the bones, we find that it is 52.6 for the calcium fed animals and 47.2 for the controls. If we calculate the average for the moist weight we find the ratio 13.1 against 11.8 mg. per 100 cc. Possibly there is a slight increase in the tissue calcium of the animals that were fed calcium, but since most of this increase comes from a few exceptional figures in single organs, notably two lymph glands and one heart, *it is not established that as a general rule the normal animals that receive calcium have more calcium in their tissues than the control animals.* There is no discernable difference in the calcium content of the animals that had received calcium for short or for long periods.

Consideration of the results with *tuberculous* animals shows while the organs which do not have tuberculous lesions (heart, kidneys, muscle), contain much the same quantity of calcium as in the same organs of non-tuberculous animals, yet in the organs showing the most marked lesions (spleen and lymph glands) the proportion of calcium is greatly increased. This illustrates the tendency of calcium to deposit even in actively progressing tuberculous lesions,† but it is to be noted that the amount of calcium in the tuberculous spleens and glands happens to be much greater in the animals that *did not* get calcium.

The calcium determinations of the lymph glands and spleens of 18 tuberculous animals regardless of presence of gross lesions in the spleens —(9 pairs)—9 fed calcium and 9 not fed calcium, show that in 5 out of 9 pairs of animals the calcium content of the *lymph glands* of the calcium fed pigs was *less* than that of the non-fed pigs. In 5 out of 9

* Possibly the fact that the peribronchial glands were included in the analysis accounts for the fact that the lymph gland figures run high, since a certain amount of inhaled calcareous dust might be present.

†Caldwell (Jour. Infect. Dis., 1919 (24), 81) found that tuberculous tissues which do not contain any macroscopic evidence of calcification often have a very high calcium content.

pairs of animals the calcium content of the *spleen* of the calcium fed pigs was *greater* than that of the non fed pigs.

However the extent of the tuberculosis lesions was much greater in the lymph glands in 7 out of 9 cases in the non-fed pigs and in the spleens in every case the extent of the tuberculosis was much greater in the non-fed than in the calcium-fed pigs, and the average calcium content of the lymph glands of the calcium fed pigs is 257.8 as against 100.5 in the pigs not fed calcium, and the average calcium content of the spleens of the calcium fed pigs is 106.7 as against 128.6 in the pigs not fed calcium.

Hence these experiments do *not* indicate that administration of large amounts of calcium causes larger amounts to be deposited in tuberculous lesions than will be the case in an animal on a normal diet which contains ordinarily adequate amounts of calcium. In considering the value of calcium in human tuberculosis it is to be considered that tuberculous patients usually receive large quantities of milk, which contains about 2 grams of CaO per liter, thus insuring an adequate supply of calcium without any therapeutic administration of this element. We are not prepared at present to discuss the problem of the effect of calcium on the course of the disease in tuberculous animals, although such experiments are under way. It is, of course, possible that calcium may influence tuberculosis in other ways than by accumulating in the lesions, as, for example, through its marked influence on chemotasis and phagocytosis, or in some less direct way.

THE EFFECT OF OXYGEN ON SUBSURFACE GROWTH OF TUBERCLE BACILLI

By H. R. Miller, M.D., and Victor Ross, M.A.

New York

Briefly, and in the way of a preliminary report, we wish to describe an effect of oxygen upon the growth of tubercle bacilli placed within a fluid medium, i. e., beneath the surface of a fluid.

It is well known that tubercle bacilli in pure culture, when seeded upon the surface of a suitable medium will readily propagate. Growth occurs as a typical parchment-like, often lamellated looking membrane. If a segment of this membrane detaches itself and sinks beneath the surface of the fluid, growth of this segment ceases. We considered it of interest and of value to ascertain how a constant stream of oxygen bubbled through a fluid medium would influence the growth of tubercle bacilli placed beneath a surface of a fluid. A constant bubbling of oxygen through the liquid ensured saturation.

In the first experiments we used glycerine meat broth. Later we observed that Petroff's potato broth made an ideal medium, because of its translucency and ease of preparation, no salt or peptone being required. The hydrogen ion concentration was between 6 and 7. Oxygen was passed through 1 per cent. potassium permanganate solution into a flask containing potato broth, tubercle bacilli having been innoculated into the broth and made to sink to the bottom of the vessel. A constant slow bubbling of oxygen was allowed to go on. Within four weeks visible, increased growth was noted. There was no membrane formation as in surface growth but rather a distinct enlargement of each particle of tubercle bacilli mass.

With the use of this method of subsurface growth we hope to procure, possibly, living tubercle bacilli from the circulating blood stream of human beings and animals infected by tuberculosis. We shall attempt, also, the study of the effect of various gases upon the subsurface growth of tubercle bacilli.

These studies were made possible by the generous financial support of Mr. Max Phillips.

SENSITIZATION EXPERIMENTS WITH THE TUBERCLE BACILLUS AND ITS PROTEIN EXTRACTS*

By Maurice I. Smith, M.D.,

Washington, D. C.

(Abstract)

Experiments were made to determine whether the assumption that the tuberculin reaction is an anaphylactic manifestation can be supported on an experimental basis. Guinea-pigs were used as the experimental animal and the anaphylatic reaction was studied by the Schultz-Dale method of the isolated uterus. The results have indicated that while animals can be readily sensitized to tuberculo-protein, it has not been possible to demonstrate sensitizing properties in "old tuberculin" of Koch. The results of experiments on general hypersensitiveness in tuberculous infection have shown that the anaphylactic state may or may not develop according to the manner of infection. Guinea-pigs infected with a suspension of washed and ground tubercle bacilli became anaphylactic to tuberculo-protein. If guinea-pigs are infected, however, with suspensions of gently macerated tuberculous tissues they fail to show evidence of general hypersensitiveness to tuberculo-protein as studied by the isolated uterus method. Such animals, however, react to intracutaneous injection of tuberculin.

It is concluded that the development of the anaphylactic state in experimental tuberculous infection appears to be dependent on sensitization to tuberculo-protein simultaneously with the introduction of the infecting organism. The experiments do not support the assumption that the tuberculin reaction is an anaphylactic phenomenon.

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* From the Hygienic Laboratory, U. S. Public Health Service, Washington, D. C. This paper will be published in full in the *Journal of Medical Research.*

A STATISTICAL REVIEW OF TUBERCULOUS LESIONS IN SIX HUNDRED AUTOPSIES*

By Isabel M. Wason, M.D.

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A striking feature encountered in any study of autopsy protocols is the frequent occurrence of lesions attributable to the tubercle bacillus. This observation is by no means new; indeed, it has been made the subject of exhaustive researches by Naegeli,[6] Burkhardt,[1] and Ghon[2] in Europe, and by Opie[9] in this country. They have proven conclusively the high incidence of tuberculous infection in children as well as adults. This analysis is presented as the result of routine examinations by twelve prosectors in the last four years and not as a painstaking investigation comparable to the above studies.

The variation of individual observations is exceedingly well illustrated in this series. The number of adults in whom lesions were found varies with different prosectors from 45 per cent. to nearly 100 per cent. These figures are comparable to the changes of Naegeli's own statistics from 40 per cent. at the beginning to over 97 per cent. in the last of his series. As the staff pathologists perform autopsies in rotation, individual inaccuracy of observation affects the total incidence but not the age curve.

The six hundred cases on which this report is based include 20 partial autopsies in which the lungs were not examined, and 57 infants, stillborn or surviving only a few hours. In the 523 more complete examinations no especial effort was made to search for tuberculous lesions, but the condition of the pleura, the apices of the lungs, and the lymph nodes were noted. Many, but not all, of the lesions were studied by microscopic section. Localized pulmonary scars near the apex, whether fibrous, hyaline, or calcified, calcified nodules within the lung, hyaline or calcified lymph nodes, and dense fibrous pleural scars or bands, when found alone, were classed as questionable tuberculosis; if two or more of these signs were combined, a diagnosis of presumptive tuberculosis was made. Only where definite caseation or tubercle formation was found, or where the tubercle bacillus was demonstrated, was the diagnosis unquestioned. In this we differ from Opie,[9] who has classified calcareous lymph nodes or nodules in the lung as definitely tuberculous, and from Naegeli who also included firm pleural adhesions near the apex, and localized apical scars.

* From the Brady Laboratory of Pathology and Bacteriology Yale University School of Medicine, New Haven, Connecticut.

CASES IN WHICH NO TUBERCULOSIS WAS FOUND

Of the 178 autopsies in which no tuberculosis was found, 109 were below the age of 20 years. Our failure to demonstrate evidences of infection in these was probably because, as Ghon and Opie have proven, lesions are more often near the hilus or scattered through the substance of all lobes in the non-lethal tuberculosis of early life and are more easily missed in routine examinations. Sixty-nine cases above the age of 20 years remain in which no tuberculosis was found. Twenty-six died of influenzal pneumonia, 20 others also showed extensive pulmonary inflammation, and in 6 the lungs were the seat of a widespread malignant new growth.

TABLE 1

AGE	NUMBER OF CASES	NO TBC.	QUESTIONABLE	PRESUMPTIVE	DEFINITE	LETHAL	% NO TBC.	QUESTIONABLE	PRESUMPTIVE	DEFINITE	LETHAL
PARTIAL AUTOPSY	20						PERCENTAGE				
LESS THAN 24 HRS.	57	57									
24 HRS. TO 1YR.	46	43			3	3	93.5			6.5	6.5
1 YR. TO 5YRS.	61	44	3		14	10	72.	5.		23.	16.
6YRS. TO 12YRS.	23	15	3		5	3	65.	13.		22.	13.
13 YRS. TO 19 YRS.	19	7	6	2	4	2	37.	32.	10.	21.	10.
20YRS. TO 29YRS.	71	23	14	17	17	6	32.	20.	24.	24.	8.4
30YRS. TO 50YRS.	149	28	33	57	31	15	19.	22.	38.	21.	10.
50YRS TO 70 YRS.	114	14	34	50	16	7	12.	30.	44.	14.	6.
ABOVE 70 YRS.	40	4	12	23	1	0	10	30.	57.5	2.5	
TOTAL-ABOVE 24 HRS.	523	178	105	149	91	46	34.	20.	29.	17.	8.8
TOTAL-ABOVE 20YRS.	374	69	93	147	65	28	18.	25	39.5	17.5	7.1

In only 17 instances were conditions favorable for the detection of a small scar or nodule. The curve is in inverse ratio to the age and descends from 93.5 per cent. in the first year to 10 per cent. in the group of 70 years and above.

QUESTIONABLE TUBERCULOSIS

Several lesions which frequently express the reaction of the body to the tubercle bacillus, but cannot be called absolutely specific when occur-

ring alone, are classified as questionable. Of these calcified glands are the most significant. Scars near the lung apex are also very suggestive and vary from small, grey, opaque, subpleural thickening to fibrous, hyaline, or calcified areas several centimeters in diameter, which histologically do not contain definite tubercles. Fibrous pleurisy, even when occurring as a dense band near the apex, is the least valuable sign, inasmuch as it may be a sequel to inflammatory processes initiated by some other agent. A number of such adhesions contained calcified nodules, although nothing significant was found in the lung or lymph nodes. In childhood calcification or occasional fibrous adhesions may be found, but pulmonary scars of greater extent are infrequent before adult life.

PRESUMPTIVE TUBERCULOSIS

The term presumptive tuberculosis is applied where two or more of these doubtful signs are combined. This group tends to parallel the age curve more than any other. No cases were found below 12 years, 2 only below 20 years, and the greatest relative number (57.5 per cent.) occurred after 70 years.

ANATOMICAL TUBERCULOSIS

Anatomical tuberculosis may be divided into two groups: *A*, Subsidiary, (45 instances); *B*, Lethal, (46 instances). The statistics of the New Haven Hospital are necessarily misleading as regards the incidence and type of tuberculosis in the community, inasmuch as chronic phthisis is not accepted, but acute forms of the disease are admitted. The average incidence of definite anatomical tuberculosis is the same for deaths above and below 20 years, but lethal tuberculosis is much higher in the latter group (12 per cent. contrasted with 7.5 per cent. in the former). Twenty females and 26 males are included in the lethal forms of the disease.

A. Subsidiary Tuberculosis

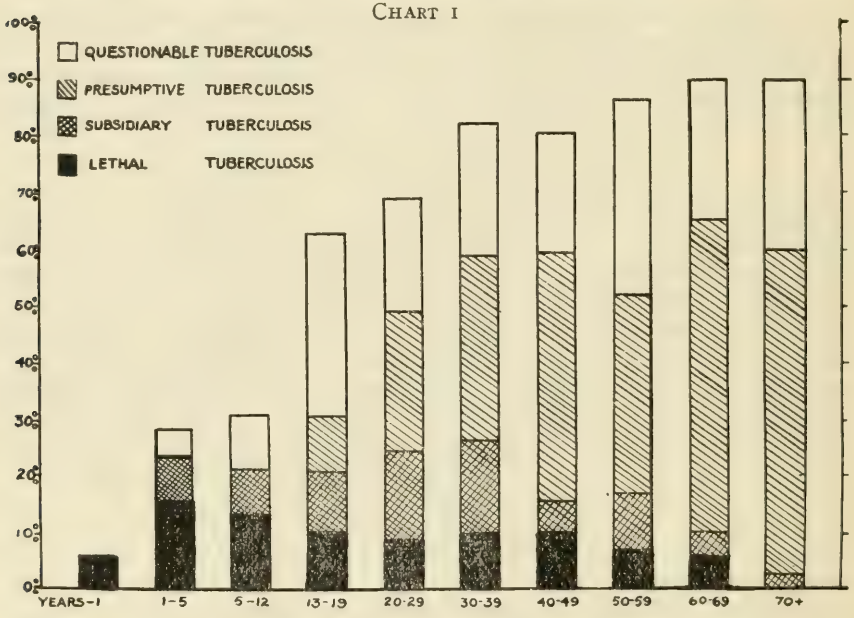
Tuberculosis as an incidental finding was observed most often in the lungs (53 per cent.) with bronchial (47 per cent.) and mesenteric glands (24 per cent.) second and third in order of frequency. A pulmonary lesion occurred but once below 5 years and in this instance was a small acute focus at one apex. The greatest incidence of this form was in the third decade (16 per cent.), but involvment of the lymph nodes was relatively more frequent in the second decade. Sinus formation, intestinal ulcers, and disseminated tubercles were found more rarely.

B. Lethal Tuberculosis

Tuberculosis was a primary or contributory factor in the deaths of 46 patients in 31 of whom fresh or healing tubercles were disseminated throughout the body indicating a recent bacteriaemia. In the other 15, the disease was more confined to one system or locality.

The group of disseminated tuberculosis shows a definite relation between age and the location of old foci. Of the 11 instances below 8 years, 4 only showed old pulmonary lesions accompanied by caseous hilic nodes; enteritis was combined 5 times with caseous mesenteric nodes, once tonsils and tracheobronchial nodes were the seat of large caseous tubercles, and in another case of a sinus of the buttock the abdominal nodes were most extensively involved. Wollstein and Bartlett [12] found primary pulmonary and bronchial node infection in 75 per cent. of 178 examples of generalized infection. Of the young adults (16-25) one exhibited old lesions in pleura and lymph nodes, and in one no focus was discovered. Seventeen of the 18 adults above 25 years showed evidence of old pulmonary tuberculosis usually with disease of the lymph nodes. In the other case all lesions seemed to be acute. Enteritis was present

CHART 1



frequently in these latter groups, but in almost every instance appeared to be of more recent origin than the pulmonary manifestations. Extensive disease of the genito-urinary tract was observed twice, and osteomyelitis of the sternum combined with an old encapsulated focus at one apex was encountered once.

The frequency of meningitis in this form of tuberculosis is well exemplified (table 2). Sixteen of the 31 cited above showed well marked tubercles in the meninges; in one (marked questionable) a slight exudate was seen which microscopically consisted of serum and small mononuclear cells, but no distinct tubercle formation. One brain was normal and

in 13 necropsies permission for its removal was not obtained. A review of the clinical history of these 13 revealed the following facts:—one showed tubercle bacilli in the spinal fluid; 2 had a clear spinal fluid under increased pressure which was not examined for tubercle bacilli, as the disease was unsuspected; in one the colloidal gold gave a slight reduction in the meningitic zone; one other patient was mentally cloudy and apathetic the last few days of life; eight showed no clinical or laboratory evidence of meningitis. No cases of meningitis were observed in which more or less widely disseminated tubercles were not also found.

Extensive pulmonary tuberculosis was encountered not infrequently (20 instances) but seldom as the sole cause of death. Of the 17 old foci of tuberculosis tabulated under disseminated tuberculosis, 6 were small and well encapsulated, 11 were of the chronic ulcerative type of the disease, and in two of the latter an acute tuberculous pneumonia was superimposed. Miliary tubercles were found in the less involved areas of lung parenchyma, as well as in other organs. The remaining 9 cases

TABLE 2

DISSEMINATED TUBERCULOSIS

		PRIMARY FOCI					BRAIN		
AGE	NUMBER OF CASES	LUNG	INTESTINE	BRONCHIAL LYMPH NODE	MESENTERIC LYMPH NODE	OTHER FOCI	NORMAL	MENINGITIS	NOT REMOVED
UNDER 1-YEAR	3	1	2	2	2			2	1
1 TO 7 YEARS	8	3	3	6	6	1-TONSIL AND TRACHEAL NODE 1-SINUS BUTTOCK		6	2
8 TO 15 YEARS									
16 TO 20 YEARS	2			1	1	1-NONE FOUND — 1 PLEURA		1	1⊙
20 TO 39 YEARS	9	9		7	3	1-OSTEO-MYELITIS	1	5	3
40 + YEARS	9	8		3		1-NONE FOUND 2-GENITO URINARY T.	1?	2	6
TOTAL	31	21	5	19	12		2	16	13

⊙ TUBERCLE BACILLI WERE FOUND IN THE SPINAL FLUID—ANTE-MORTEM.

comprise 7 which terminated with acute non-tuberculous diseases, (one pyopneumothorax, 3 pneumonia, 1 gangrene of lung, 1 arsenical poisoning, 1 streptococcus peritonitis), and 2 of acute ulcerative tuberculosis following influenza. In both of the latter small encapsulated lesions were present in the upper lobes.

Four examples of peritonitis occurred, 3 in children between 1 and 2 years of age, and the fourth, in a woman of 44 years. Acute caseous

cervical lymphadenitis and tuberculous osteomyelitis were each noted once.

DISCUSSION

In the Transactions of the Fifteenth Annual Meeting of the National Tuberculosis Association, Colonel G. E. Bushnell [2] calls attention to the marked discrepancies in the finding of anatomical tuberculosis by different pathologists and in different localities. Especially has this been true for the soldiers autopsied in the field as opposed to the careful studies of Burkhardt, Naegeli and Opie on the civilian populations. Thus Oberndorfer [7] found tuberculosis in only 10 per cent. of the German soldiers at necropsy. Robertson [10] working with Aschoff at Freiburg, found tuberculosis in 70 per cent. of the German soldiers, but later using similar methods, he was able to demonstrate it in only 25 per cent. of the American soldiers, and Glomsett [4] in only 16 per cent. of the American soldiers autopsied at Base Hospital No. 15.

Naegeli, in 420 autopsies on adults at Zurich in 1896-1898, found the incidence of lesions which he called tuberculous to be 93 per cent.; and of the last 284 of the series tuberculosis was found in over 97 per cent. Burkhardt in Dresden, a few years later, found tuberculous lesions in 91 per cent. of 1262 sections. Opie, at St. Louis has found in a small series of 50 adults the highest incidence in this country, 100 per cent.

Two explanations for the above conflicting percentages may be given; (1) that the very careful methods of Naegeli, Burkhardt and Opie, rarely applicable in the field, would have revealed a much higher percentage of tuberculous lesions; (2) that in the more vigorous young adults comprising a large proportion of the army, tuberculous lesions were present in a much lower percentage or as such minute foci that they were not found.

The occurrence of tuberculosis in children, according to different observers, shows similar variations. Of the 190 children in Burkhardt's series, 72 or 38 per cent. showed tuberculosis, and in 35 of these the lesions were lethal. Naegeli found tuberculosis in 15 of 88 children, in 11 of whom it was the cause of death. Wollstein reports a decreasing amount of tuberculosis in children below 5 years in the three periods of her reports, 16.4 per cent. between 1889-1908, 13.5 per cent. 1908-1914, and 9 per cent. 1914-1920. Opie found tuberculous lesions in 15 per cent. of children below 5 years with a mortality from the disease of 11 per cent. Our statistics parallel these closely, with an incidence of 16 per cent. and mortality of 12 per cent. We also found questionable evidence, chiefly calcified lymph nodes, in three additional cases.

The incidence of lesions definitely or questionably tuberculous in relation to age is shown in table 1 and chart 1. The curve of incidence rises steadily from the first to the seventieth year, but after the fifth year the increase is in questionable or presumptive types which represent healed forms of the disease, and not in the lethal or definitely anatomical tuberculosis. Indeed, after the fourth or fifth decade the latter types decrease. The average percentage of adults in whom no evidence of infection was found (18 per cent.) is from 9 per cent. to 18 per cent. lower than those of Burkhardt, Naegeli, and Opie. These figures represent the difference between the routine autopsy in which no particular effort is made to search for tuberculous lesions and the autopsy in which unusual care is required to find the focus on account of its small size or position. The statistics of Robertson and Glomsett on soldiers' necropsies are comparable to the 24 per cent. of definite anatomical tuberculosis found in civilian population between the ages of twenty and thirty years.

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THE LYMPH NODE DISTRIBUTION OF EXPERIMENTAL TUBERCULOSIS IN THE GUINEA PIG

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Nearly twenty years ago, Harbitz wrote, "I had noted the frequent, often very extensive, and sometimes even general, tuberculosis of the lymph nodes, and its primary occurrence, especially in relation to pulmonary tuberculosis, in children."[1]

This was the starting point of his important researches upon active and latent tuberculosis in childhood, in connection with which he observed in a number of cases very widely distributed lymph node disease, not infrequently healed or healing.

Other observers have confirmed the reports of Harbitz,[2 3 4] and Col. Bushnell and some other members of the Medical Corps of the United States Army[5 6] have based theories and careful studies of the mode of extension of tuberculosis upon the wide-spread involvement of the lymphatic system, especially in early life.

Harbitz, following the lead of Loomis[7] and Spengler,[8] also found virulent tubercle bacilli rather often in apparently normal lymph nodes, and believed the evidence favored dissemination of tuberculosis in the lymphatic system, frequently followed by reduction of virulence and rather prompt dying out of the bacilli, in the living host. In this he agreed with Perez[9] and Manfredi and Frisco,[10] who had reported attenuation and death of bacilli in the lymph nodes of rabbits and guinea pigs a few months after inoculation by certain special methods.

We may note in passing that so far as the guinea pig is concerned, a good many transplants of tuberculous inguinal nodes have not given us any evidence of such attenuation in the tissues of this animal when they are transplanted in a fresh state, though the excised nodes when kept in the incubator lose all power to infect in a very few days.[11 12 13 14] Cobbett, moreover, on the basis of the great numbers of inoculations performed by the British Royal Commission, states that emulsions of tuberculous lymph nodes and other tissues are not less virulent than emulsions of free bacilli from cultures, but more so.[15] Much no doubt depends on the number of bacilli and the portal by which they are introduced. In a number of animals inoculated in various ways, for example by inhalation, and by subcutaneous inoculation with drying cultures, we have noted at least relative arrest of the tuberculous process in the

lymph nodes, and we attribute decided importance to the views of Perez, Manfredi and Frisco, and Harbitz in this matter, provided the method of inoculation is suitable, that is, not overwhelming. Whether in these circumstances the bacilli become attenuated, or die, or are merely retarded owing to small numbers, is not certain.

The present paper, however, is not mainly concerned with virulence, attenuation, and latency, but with the distribution of demonstrable lesions in remote groups of lymph nodes after subcutaneous inoculation in the guinea pig.

Following the publication of Krause's article on "Tuberculosis in the Guinea Pig with Particular Reference to the Tracheo-Bronchial Lymph Nodes,"[16] we had some correspondence with him, in the course of which he wrote, "I have an idea that you will find, if you go far enough, that many remote nodes (remote from the portal of entry or a diseased viscus) take on a little tubercle (microscopic) which later heals."[17] This stimulated us to continue some experimental work which we had begun upon the occurrence of tuberculous lesions in the mesenteric nodes of guinea pigs inoculated subcutaneously, and to expand this work to include the ileo-cecal, axillary, and cervical nodes. This work is here reported.

Our first series (table 1) was made up of tuberculous guinea pigs which came to autopsy in the course of other work in the laboratory. At first only the mesenteric (a very large single node) and the ileo-cecal (a small node near the ileo-cecal valve) were examined, later the deep cervicals also. Lesions of mesenteric or ileo-cecal nodes or both were found in about half the members of this series examined three to fifteen weeks after subcutaneous inoculation at about the level of the umbilicus, with emulsions of tubercle bacilli or with tuberculous tissues, the former perhaps producing the effect somewhat more quickly than the latter, probably owing to obvious mechanical factors which we have mentioned in previous papers on transplantation of tuberculous tissues. The cervical nodes, when examined, usually showed more advanced lesions than the mesenterics.

The first series, in short, made it appear that the mesenteric nodes are apt to show lesions on careful examination within a few weeks after subcutaneous inoculation, but that they lag somewhat behind other remote nodes in the development of lesions. The second series (table 2) was undertaken to verify these observations if possible, to enlarge their scope by examining the deep cervical and also the axillary nodes microscopically in every case, and to rule out the possibility that mesenteric node disease was dependent on absorption of bacilli from the intestine. The guinea pigs were divided into two groups. Those of the first group (I^{11}—V^{11}) were inoculated as before, under the skin of the belly, and were kept for several weeks after the formation of open ulcers, from which ingestion of tubercle bacilli was possible. Those of the second group were inoculated in the areolar tissue of the groin, where ulcers do not form so readily, were isolated, and upon the appearance of ulceration in

TABLE 1

NUMBER OF GUINEA PIG	WEEKS SINCE INOCULATION	FORM OF INOCULATION	TUBERCULOUS LESIONS AT AUTOPSY									
			Gross							Microscopic		
			Right inguinal nodes	Left inguinal nodes	Spleen	Liver	Hepatic node	Lung	Bronchial nodes	Mesenteric node	Ileocecal node	Deep cervical nodes
IV[1]	3	Tubercle emulsion, right subcutaneous	+	0	+	+	++	0	0	0	0	–
R	5	Tuberculous urine, right subcutaneous	+++	0	++	+	+	0	+	0	0	–
2[iv]	5	Tubercle emulsion, right subcutaneous	+++	+	+++	0	++	0	+	0	+	–
C	6	Tubercle emulsion, left subcutaneous	+	+++	++	+	+	0	+	+	0	++
A[3]	6	Tuberculous sputum, right subcutaneous	+++	0	++	+	++	0	++	0	0	0
2[1]	8	Tubercle emulsion, right subcutaneous	++++	0	++	+	++	0	0	0	0	–
6	9	Tubercle emulsion, right subcutaneous	+++	0	++	+	++++	0	+	0	0	–
I	9	Tuberculous node, right subcutaneous	++	++	++	++	++	+	+	0	+	–
I[vi]	9	Tuberculous node, right subcutaneous	++	+	+++	+++	+	+	+	+	+	++
II[v1]	9	Tuberculous node, right subcutaneous	+++	0	++	++	+	0	0	+	0	+
2[11]	10	Tubercle emulsion, right subcutaneous	+++	0	+	0	++	0	+	0	0	–
1	12	Tubercle emulsion, right subcutaneous	++++	++	++	+	+++	+	+++	++	0	–
3	15	Tubercle emulsion, right subcutaneous	++	+	+++	+++	+++	++	+++	0	0	–

0 = no lesions found by method indicated.
– = not examined.

the group were killed and autopsied, most of them being still free from ulcers. This resulted in the second group being killed somewhat sooner after inoculation than the first. Nevertheless, of six pigs killed five weeks after inoculation by this method, four had lesions of the mesenteric nodes, two had lesions of the ileo-cecal nodes also, five had lesions of the axillary nodes, and all had lesions of the cervical nodes, while two pigs killed three and a half and four and a half weeks after inoculation had lesions of the cervicals and axillaries, but none of the mesenterics or ileo-cecals. In the controls, four of which had had open ulcers for from fourteen to twenty-two days, the results were essentially the same at autopsy six weeks after inoculation. In other words, mesenteric node tuberculosis developed in the absence of the possibility of alimentary infection as well as in its presence, and in both cases was somewhat less advanced than tuberculosis of remote nodes accessible only through the circulation, and did not so often show caseation. As regards such remote nodes, there was no apparent difference in the degree of involvement of the two groups examined, the deep cervicals and axillaries.

One more point required to be elucidated, that is, the question whether the axillaries and cervicals of the side inoculated were reached directly by absorption through the cutaneous lymphatics or only as part of a general infection. To settle this we did a third series (table 3) keeping the right and left nodes carefully identified. There was no considerable difference between the two sides, and in other respects the results of this series supported the inferences drawn from the previous ones.

In addition to the nodes indicated in the tables, the iliac nodes of the side inoculated and the retroperitoneal nodes were involved in all pigs examined, while in a few cases the submaxillary nodes showed gross lesions.

It is evident from these experiments that in the guinea pig after subcutaneous inoculation the lesions of tuberculosis soon become generalized throughout the lymph nodes of the body, their involvement being fairly parallel with the visceral generalization of the disease, and that apart from the primary involvement of the regional nodes in the direct line of absorption, this distribution of lesions has no topographical connection with the location of the point inoculated. So far our work is in accord with the observations and opinions cited at the beginning of this paper.

As regards the other question, whether these lesions tend to become quiescent and even heal, we have not as yet much evidence, as most of the animals have been kept less than two months after inoculation. In the few animals kept longer there was no evidence of healing lesions, though some of them were negative. It is apparent however that these lesions do not tend to progress, as does tuberculosis of the regional nodes adjoining the area of primary inoculation. We have an excellent opportunity for comparison in a hitherto unreported group of guinea pigs which were inoculated by dripping an emulsion of tubercle bacilli into the

TABLE 2

NUMBER OF GUINEA PIG	DAYS SINCE INOCULATION	FORM OF INOCULATION	ULCER	TUBERCULOUS LESIONS AT AUTOPSY													
				Gross							Microscopic						
				Right inguinal nodes	Left inguinal nodes	Spleen	Liver	Hepatic node	Lung	Bronchial nodes	Mesenteric node	Ileocecal node	Cervical nodes		Axillary nodes	
													Right	Left	Right	Left
			days													
II^{mn}	25	Tubercle emulsion, left groin	0	0	++	++	+	+	0	0	0	0	+	+	+	+
VI^{mn}	32	Tubercle emulsion, left groin	+1	0	++	+	+	+	0	0	0	0	+	0	+	+
I^{mn}	36	Tubercle emulsion, left groin	+2	+	++	++	+	+	0	+	+	+	+	+	++	++
III^{mn}	36	Tubercle emulsion, left groin	0	0	0*	++	+	+	0	+	+	+	+	+	++	++
IV^{mn}	36	Tubercle emulsion, left groin	0	+	++	+	0	+	0	+	+	0	+	+	++	0
V^{mn}	36	Tubercle emulsion, left groin	+1	+	++	+	+	+	0	++	+	0	++	++	++	++
VII^{mn}	36	Tubercle emulsion, left groin	0	+	++	++	+	+	0	0	0	0	+	−	+	+
VIII^{mn}	36	Tubercle emulsion, left groin	0	+	+	+	0	0	0	0	0	0	+	0	0	0
I^{x1}	43	Tubercle emulsion, right abdominal subcutaneous	+18	++	0	++	0	+	0	+	0	0	+	0	++	0
II^{x1}	43	Tubercle emulsion, right abdominal subcutaneous	+14	++	+	+	+	+	0	0	+	+	+	+	+	0

* Left iliac ++.

III[x1]	43	Tubercle emulsion, right abdominal subcutaneous	0	+	0	++	+	++	0	+	−	++	0	+	0
IV[x1]	43	Tubercle emulsion, right abdominal subcutaneous	+22	+++	0	+++	+	++	0	+	−	++	0	+	++
V[x1]	43	Tubercle emulsion, right abdominal subcutaneous	+22	++	0	++	+	++	+	++	+	+	0	++	++

nose, according to the method of Mullin and Ryder.[18] Incidentally, we have never had any difficulty in producing extensive pulmonary effects by this method without the use of any anaesthetic or other preparatory manœuvre in rabbits; when we undertook the same experiments with guinea pigs we had some negative results until it occurred to us to give a little ether as a preliminary step. Perhaps the larger animal is more phlegmatic; a greater general nervous irritability in the guinea pig would account for better laryngeal control. A propos, guinea pigs use their voices and rabbits do not, and this practise in the use of the laryngeal muscles may contribute to the guinea pig's greater ability to exclude foreign fluids from the lower air passages. If the guinea pig is given ether to very light anaesthesia, this difficulty is obviated. Most of these guinea pigs developed extensive primary tuberculosis of the lungs, but a few had conspicuous massive enlargement and caseation of the cervical nodes, and little or no tuberculosis beyond this after as much as fifteen weeks—a typical picture of scrofula. Cornet[19] long ago reported similar results. Manfredi and Frisco noted primary lymph node tuberculosis without known lesion of the mucous membrane in guinea pigs but not in rabbits, and the results as regards cervical nodes in Mullin's and Ryder's rabbits on the one hand, and our guinea pigs on the other, are in entire agreement with this. The nodes in these pigs were large enough to attract instant attention on cursory examination of the living animal. This is very much in contrast to the appearance of the same nodes as they are affected in the general process which we have been describing in this paper. This latter type of lymphadenitis very rarely causes enough enlargement to attract attention in the living animal, and at the time at which we made our examinations could not as a rule be diagnosed with certainty except by microscopic examination. And between the shortest and the longest time intervals there did not seem to be much tendency for the lesions, once they had reached a moderate size and a moderate degree of caseation, to progress farther. The tracheo-bronchial and hepatic nodes not infrequently exhibit exceptions to this rule, but they, as Krause has shown, are particularly exposed, for anatomical reasons, to massive cumulative infection. In a few scattered instances, not all included in this series, we have found microscopic areas of calcification associated with tuberculous caseation in the lymph nodes of guinea pigs, but we have also found it in the spleen in a particularly severe tuberculosis following intraperitoneal inoculation.

The sharp distinction between the massive involvement of regional nodes draining the area of primary inoculation, and this slight though constant and general secondary involvement of distant nodes, is in harmony with the difference between the lymph node involvement in childhood ("primary") and adult ("secondary") human tuberculosis, which has often been noted and has of late been beautifully presented by Opie.[20 21 22 23 24]

As for the route by which the distant nodes are involved, we accept the

TABLE 3

Number of Guinea Pig	Days Since Inoculation	Form of Inoculation	Ulcer	TUBERCULOUS LESIONS AT AUTOPSY													
				Gross								Microscopic					
				Right inguinal nodes	Left inguinal nodes	Spleen	Liver	Hepatic node	Lung	Bronchial node	Retrosternal node	Mesenteric node	Ileocecal node	Cervical nodes		Axillary nodes	
														Right	Left	Right	Left
			days														
Imn	33	Tubercle emulsion, right groin	+10	++	0	+++	+	+	0	+	0	+	0	+	+	+	—
IImn	33	Tubercle emulsion, right groin	0	+++	+	++	+	+	0	0	0	+	+	+	+	++	++
Ixiii	41	Tubercle emulsion, right abdominal subcutaneous	+18	+++	+	+++	+++	+++	0	+	+	++	++	++	+	++	++
IIxiii	33	Tubercle emulsion, right abdominal subcutaneous	+10	+++	+	++	++	+	+	+	+	+	+	+	++	++	++
IIIxiii	33	Tubercle emulsion, right abdominal subcutaneous	+10	++	+	++	++	+	0	+	+	+	+	+	+	++	+
IVxiii	41	Tubercle emulsion, right abdominal subcutaneous	+18	+++	+	+++	+++	+++	++	++	+	+	+	++	++	++	++

ideas advanced by Krause[16 25 26] to explain involvement of bronchial nodes when no lesion of the lungs can be found: bacilli are carried from the region of inoculation by the lymphatics as far as the great veins of the thorax, thence into the right heart and out into the lungs by the pulmonary arteries. There some of them pass from the capillaries into the lymphatics and are concentrated upon the bronchial nodes and there retained in sufficient numbers to cause lesion. The rest pass on to the left side of the heart and out in the general arterial circulation, where the same thing that happened in the lung is repeated in the drainage field of every lymph node—bacilli pass through capillary walls into lymphatics, and thus are concentrated upon the lymph node into which these lymphatics drain. This theory of dissemination seems much better founded that any theory which assumes a general to and fro communication between all parts of the lymphatic system, without the mediation of the circulating blood.[1 27]

It may be worth noting that in several instances where the deep cervical nodes were tuberculous we examined also the thymus glands, which in the guinea pig are lobulated structures situated on each side of the neck just over the deep cervical nodes and somewhat larger than these, and always found them free from lesion; that is to say, the lesions of the lymph nodes are not simply part of a uniform general miliary tuberculosis, but depend on other factors of which we consider this process of lymphatic concentration by far the most important.

The fact that the axillary and cervical nodes are involved a little before the mesenterics may perhaps be explained by the greater rapidity of the lymph flow through the latter—a concept often invoked by those who believe that tubercle bacilli are acquired through the intestine without producing discoverable lesions either in it or in its lymph nodes.[1 28 29 30]

In interpreting his cases of disseminated lymph node tuberculosis in children, Harbitz considered three possibilities. First, the invasion of several groups of lymph nodes from simultaneous primary lesions, or penetrations of epithelial surfaces, for example the cervical and mesenteric nodes from the pharynx and intestine; second, hematogenous dissemination, which he felt to be not infrequent in infants; third, extension from group to group within the lymphatic system, apart from the commonly recognized paths of centripetal drainage. Harbitz, following Weigert,[27] believed this to be not only possible, but usual, and accepted it as the most important way in which disseminated lymph node tuberculosis developed. He also felt, as Weigert did, that the blocking of lymph vessels and nodes by the lesions might well lead to a stoppage or reversal of the usual current of lymph flow, with a consequent spread of the disease *out* the lymphatics against the normal current, as is argued in the case of hilus-peribronchial tuberculosis. In pulmonary tuberculosis of children however, he thought, like Ghon,[31] that ulceration of a caseous lymph node into a bronchus was more important.

Harbitz also made some observations on animals, and wrote concerning these:

"The numerous subcutaneous inoculations of guinea pigs, which I have performed in connection with this work, have shown that the infection first has passed to the inguinal nodes, then to the retroperitoneal nodes and to the liver and spleen, thence upward to the posterior mediastinal and hilus nodes, and finally to the supraclavicular and cervical nodes. Later the lungs become the seat of scattered tubercles, apparently by lymphogenous infection from the hilus nodes, or perhaps by way of the blood. This is the very route which we previously assumed that tuberculous infection might take in its upward extension from the abdominal cavity. I am quite convinced that infection in man not rarely takes place in this manner, and that as a result not seldom the picture of generalized lymphatic tuberculosis is obtained."

With this interpretation, as regards the guinea pig, we do not at all agree. As already stated, we believe with Krause that what occurs is a hematogenous dissemination, with a reconcentration of the bacilli, through the lymphatics, upon the lymph nodes. The early infection of remote nodes, as shown by Krause for the tracheo-bronchials, the occurrence of "bacillemia" after inoculation as shown by Calmette and his school,[30] and the practically simultaneous development of lesions in many remote groups of nodes in our experiments, all support this belief. In the human body the situation may not be exactly the same. It is of course always dangerous to draw close analogies between one animal and another.* But our impression is that conditions are closely similar.

Two cases seen recently at autopsy have a bearing on this problem of lymphatic routes. In one case there was massive carcinoma of the right lung, and of the hilus and tracheo-bronchial nodes, but of no others, so far as could be ascertained. In the other case there was a primary embryonal carcinoma of the left testicle, with metastases in the left iliac nodes but not the inguinals, a great metastatic mass in the position of the left aortic nodes, and another filling the posterior mediastinum. But there was found no involvement of the mesenteric nodes, lung, hilus nodes, cervical or axillary nodes. We have noted a similar phenomenon in the guinea pig in some unreported experiments. After injection of India ink into the peritoneal cavity the omental nodes were blackened, but, in one instance, not the mesenteric; the retrosternal, but not the bronchials.

That is to say, the lymphatics along the anterior and posterior body walls communicate: the peritoneals (also the cervicals[32 33]) with the anterior mediastinals, the retroperitoneals with the posterior mediastinals. But lymphatic communications between developmentally separate systems, as between the mesenterics and bronchials, or even between the mediastinals and bronchials, are not the rule, and seldom appear to occur except through the mediation of the blood stream.

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* For example, we injected India ink into the spleens of guinea pigs, and failed to find any lymph nodes receiving drainage directly from it. This confirms an opinion expressed by Krause.[16 17] The carbon was apparently carried by the splenic and portal veins to the liver, there dispersed, and part of it taken up by the lymphatics and carried to the portal (hepatic) node. In man, on the other hand, there are splenic nodes, though it is possible that they drain only the capsular tissue.

CONCLUSION

Subcutaneous inoculation of tubercle bacilli in the guinea pig is followed by early development of lesions in the lymph nodes of various remote regions of the body, often without any lesions of the areas draining into these nodes being apparent either at the same time or later. The nodes in which lesions have been demonstrated include the inguinals of the side inoculated (primary), inguinals of the other side, iliacs, aortics, axillaries, two groups of cervicals, retrosternals, tracheo-bronchials, hepatics, mesenterics, and ileo-cecals.

Except in the inguinal nodes primarily involved, and in the bronchial and hepatic nodes, which by their position are particularly subject to cumulative infection, the tendency of these widespread lesions of the lymph nodes is to reach a rather constant standard characterized by slight enlargement and moderately extensive caseation, and then to progress no farther. Lesions of the nodes draining the intestine (mesenteric and ileocecal) develop a little later, and show less tendency to become caseous, than those of the other nodes examined. Arrest and healing perhaps occur, but have not been proved in these experiments.

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THE INFLUENCE OF THE INHALATION OF COAL DUST UPON TUBERCULOUS INFECTION IN THE GUINEA PIG*

By H. S. Willis, M.D.

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(Abstract)

This study was undertaken in an effort to throw further light upon the role of the lymphatic system in tuberculous infection of the lung. Guinea pigs were exposed for varying lengths of time to coal dust; the shortest being one hour and the longest one year (of approximately fifty hours a month).

There is a gradual accumulation of dust in the lungs along the walls of bronchi, in the lymphoid tissue at dividing points of arteries and bronchi, in the alveoli and their walls, and in areas under the pleura which in all probability correspond to the borders of the secondary lobules. Grossly, the lungs slowly lose their normal pink color and become grayish pink. But even after a year's exposure to the dust there is not as much dust in any part of the lungs as there is in the lungs of guinea pigs which have been allowed to live a caged life for as long as two years. There is no fibrosis, although there appears to be some proliferation of the lymphoid cells in the presence of dust particles.

The tracheobronchial lymph nodes become grayish and somewhat enlarged but there is no development of fibrous tissue.

Animals dusted from three to twelve months were inoculated subcutaneously in the right groin with tubercle bacilli (strain H37) together with control animals. Dusted lungs show approximately one third more foci of tuberculosis in the pleura than the controls do, but there is no constant relation between the distribution of dust and infection. The lesion in the dusted lung, if more abundant, is more circumscribed and appears to be less "invasive."

No difference is noted in the tuberculous process in the tracheobronchial nodes of the dusted and nondusted animals.

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* From the Kenneth Dows Tuberculosis Research Fund of the Medical Clinic of the Johns Hopkins University and Hospital.

This paper will appear in full in a subsequent number of the American Review of Tuberculosis.

THE TRACHEOBRONCHIAL LYMPH NODES OF THE RABBIT AND THEIR BLOOD SUPPLY

By H. S. Willis, M.D.

Baltimore

(Abstract)

Several differences in the anatomy of the lung and tracheobronchial lymph nodes of two experimental animals, rabbit and guinea pig, have been pointed out. There is a much greater amount of lymphoid tissue in the lung of the rabbit while the tracheobronchial nodes are less well developed. The blood supply to the lymphoid tissue within the lung of the two animals is quite different.

These factors have suggested a further anatomical examination of the structures in question. A study of the tracheobronchial lymph nodes in the rabbit shows that they are soft, brownish, fatlike bodies, considerably smaller (relatively and perhaps actually) than are these structures in the guinea pig. They measure about 5x2x1 millimeters and occur more constantly on the right side. They are absent or are present only in microscopic size in twenty per cent. of animals. On section they are less dense, the individual cells are further apart and the germinal centres are smaller and more numerous than is the rule in other lymphoid tissue.

The nodes are supplied with blood in a constant manner. From the subclavian artery on each side a vessel arises and passes caudally in the hollow of the thorax. It supplies the first four or five intercostal spaces and sends usually three small branches to the tracheobronchial lymph nodes and the fatty tissue in each side of the mediastinum and to the lower esophagus and trachea, along which it continues and becomes the bronchial artery. The vessels frequently anastomose with their fellows from the side opposite.

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*From the Kenneth Dows Tuberculosis Research Fund of the Medical Clinic of the Johns Hopkins University and Hospital.

This paper will appear in full in a subsequent number of the American Review of Tuberculosis.

AN INVESTIGATION ON ACID FASTNESS OF TUBERCLE BACILLI THIRD REPORT*

By B. Suyenaga, M.D.

Cincinnati

Since Ehrlich and Koch discovered the acid and alcohol-fastness of tubercle bacilli the studies on the substance responsible for this special tinctorial character have been quite extensive. This is especially true in connection with the studies of immunity to tuberculosis. The waxy substance of tubercle bacilli naturally caught the attention of workers because a thorough understanding of the nature of the special substance of tubercle bacilli might help to solve the problem of immunity to tuberculosis. This might follow not only for immunological but also for chemotherapeutic studies.

According to the ideas of Ehrlich the main purpose of chemotherapeutic studies is to find a substance which has a special affinity for the virus or for some particular substance in the virus. With this in mind, it is easily seen how important it is to study a substance of tubercle bacilli which is really characteristic. The biochemical nature of this substance, the physical state of this substance in tubercle bacilli, its difference from similar substances in other acid-fast organisms, are some of the most important subjects, especially now when the nutrition of acid-fast bacilli, the chemotherapy of tuberculosis and leprosy, and immunological studies of tuberculosis from the bio-chemical view points are being conducted so diligently.

This report is only an attempt to touch upon and to clarify some aspects of acid-fastness of tubercle bacilli and is divided into two parts.

PART I

THE EXPLANATION OF ACID-FASTNESS OF TUBERCLE BACILLI

The most generally accepted explanation for the acid-fastness of tubercle bacilli was advanced first by Ehrlich. According to that, tubercle bacilli have fatty coats which prevent them from being easily stained, and when once stained, keep them from being easily destained. Here, therefore, the fatty coat itself is not stainable, but only serves to protect

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mechanically the special staining of the bacilli. But it was found later by Gottstein that there are some other fatty substances, including lanolin and cholesterin, which are themselves acid-fast.

When Tamura analyzed tubercle bacilli chemically, he extracted a waxy substance which he called mycol. This was both acid-fast and Gram positive. Tamura, therefore, concluded that there was no necessity of a membrane theory to explain the acid-fastness of tubercle bacilli; that the waxy substance could be distributed throughout bacillary bodies, giving rise to the acid-fast stain.

Then Benian and Shermann proved that tubercle bacilli lost their acid-fastness after being crushed mechanically.

Being interested in these puzzling observations and experiments, I tried to clarify the question by working as carefully as possible, though the amount of work itself is very little. The material for this work was obtained through the kindness of Dr. Esmond R. Long from Saranac Lake Laboratory and is the powdered tubercle bacilli. The strain is H-37 and it was ground in the ball mill for a month.

The material was stained by Ziehl-Neelsen's method with and without a counterstain. Various periods of decolorization were employed. The stained preparations at first gave me the impression that the powdered tubercle bacilli had lost their acid-fastness entirely, and took the blue counterstain, but upon careful examination there were found many spots of red substance. The specimen without a counterstain showed such red-stained spots more distinctly. They took the form of finger prints. The powdered tubercle bacilli stained very intensively and uniformly by Gram's method.

In the midst of this work there appeared a statement from Momose about this subject. He mentioned that tubercle bacilli when crushed lost their acid-fastness but he could collect the substance which is acid-fast by treating the material with NaOH.

CONCLUSIONS

First: It is possible that the tubercle bacillus has a waxy coat which is itself acid-alcohol-fast. It only appears to lose its acid-fastness when crushed, because then the pieces of the waxy film are covered by the plasmatic contents of the bacillus and these are intensively stained by the ordinary aniline stains used for contrast.

Second: The tubercle bacillus does not lose its Gram-positiveness when crushed.

PART II

This is a continuation of the work undertaken in the previous two reports, that is, to determine whether the younger tubercle bacilli are less acid-fast or not. In the second report on this subject, K^1 strain in suspension showed that it did not stand exposure to 0.5 per cent. NaOH

solution longer than two hours. Here we report on the action of the same strength of NaOH on K^1 cultures of various ages.

TECHNIQUE

Glycerine agar was tubed from the same stock and the water of syneresis was poured off the slants. After inoculation the cultures were connected by rubber tubing to plugged tubes containing sterilized distilled water. Thus I tried to keep the moisture of all the culture media uniform. The resistance of cultures one day, six days, and eleven days old was studied.

One hundred mgs. of the culture was weighed, made into fine paste with a few drops of sterilized salt solution in the mortar, then it was diluted with the rest of 50 cc. The suspension was filtered through a thick layer of cotton—approximately the same in each instance. Now 35 cc. of the suspension was mixed with the same amount of 1 per cent. NaOH. Then the mixture was put into a sterilized glass-stoppered bottle and was thoroughly shaken. After various intervals 10 cc. was pipetted out into sterile Petri dishes and made neutral to litmus with N/3 HCl; centrifuged for twenty minutes; and 5 loopfuls of the sediment inoculated upon 3 tubes of each of Petroff's media, and glycerine agar.

RESULTS

There was a great difference in the amount of growth which the younger and older cultures yielded after 20 and 30 minutes exposure to the alkali. This was most striking after three days incubation. The one-day old cultures yielded only a few colonies, whereas the six and eleven day old cultures yielded a heavy growth.

After one hour's exposure to the alkali, the one day old culture only yielded a few colonies in one of three glycerol agar tubes; the six day old set gave no growth; while the eleven day old culture showed many surviving organisms.

After three hours' exposure there were no survivals from the one day and six day cultures but sub-cultures from the eleven day old culture grew a few colonies on both glycerol agar and Petroff's media.

Based on the facts that the younger cultures of K^1 have more non-acid-fast bacilli than older cultures; and as shown by my previous work, that the bacilli in the periphery of colonies are less strongly acid-fast than those in the central portion; and since these younger cultures are shown by this experiment to be less resistant to NaOH, it seems fair to conclude that the younger forms are the non-alkali resistant, non-acid-fast ones.

PRELIMINARY REPORT OF THE STUDIES ON THE PARASITISM AND SAPROPHYTISM OF TUBERCLE BACILLI*

By B. Suyenaga, M.D.

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Dr. Allen K. Krause, after reviewing the extensive literature on the acid-fast organisms in lower animals and grass, emphasized the fixity of the species of these organisms; and it is true that the ever increasing stock of acid-fast organisms presents numerous strains, each with unique characters. Along with Moeller's timothy bacilli, grass bacilli and mist bacilli, we have about a dozen acid-fast organisms, one of which was isolated from sputum, another appeared spontaneously on Petroff's media and still another was isolated from a guinea pig. Each differs from the others in the manner of growth, in the form of colonies and in the pigmentation. But it is another question as to how these differences have evolved.

The K^1 strain of human tubercle bacilli which is now a saprophyte is also unique in many respects. It is not like any other acid-fast saprophyte mentioned so that we can identify it from others by its cultural features. The bacilli of the K^1 strain are usually much larger than ordinary virulent tubercle bacilli. Its cultures contain many non-acid fast elements—sometimes an overwhelming majority. It grows very rapidly; we can get quite good growth in 24 hours. It produces much alkalinity. The fatty coat of the K^1 strain seems to be quite thin; and as shown by my work it is much more easily destroyed by sodium hydroxide solution than that of virulent tubercle bacilli.

We became interested to know how and when such changes of K^1 occurred; when they lost their virulence; and when they lost their acid-fastness; how they became so different from other acid-fast saprophytes; and what is the correlation in the metabolic and immunological relations between these saprophytes. To facilitate these studies, the most feasible method to adopt seemed to us first to restore the virulence of the strain if possible. It seemed to be highly interesting to see if the acid-fastness could be restored proportionately with the virulence, or if such a relation would be different according to the routes by which the tubercle bacilli were introduced into the body. For this purpose animal passages of the strain have been resorted to for about a year and a half.

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REPORT OF PASSAGE THROUGH GUINEA PIGS

A few days' old culture of K^1 was weighed and a fine suspension made in normal salt solution so that each cc. contained 5 mg. of bacilli. Each guinea pig received 10 mg. intraperitoneally regardless of its body weight or age. All received the injection in the left groin where the hair was cleanly cut and sterilized with alcohol so that the lesion could be well observed. After a certain period the animal was killed by illuminating gas, and the spleen taken out aseptically. The spleen was cut and crushed into pieces and inoculated upon five tubes each of glycerol agar, Petroff media, and glycerol serum. They were incubated after the plugs were paraffined. When growth was obtained, the colonies, preferably those appearing on glycerine serum or Petroff's media were subcultured to glycerol serum, within a few days, and the fresh culture used for a similar passage. Later we adopted the rule to use four guinea pigs for each passage; two were killed for one set of cultures and the other two killed two days later for the same purpose. Thus the retention of K^1 in the animal body was to be lengthened gradually, passage after passage.

SUMMARY OF RESULTS

Eighty-two guinea pigs, weighing mostly between 300 and 500 gms., were injected with the isolated K^1 in different passages; 56 of them were killed for the isolation work, the rest (26) being used later, for further injections in connection with immunization. About 20 were between 200 and 300 gms., a few being over 600 gms. Thirty-two isolations were made. Among them 15 ended in success and the last one has made the thirteenth passage.

The isolation from the first passage was successful 3 days after the injection of K^1 and the second isolation after the bacilli had been in the animal for 7 days. In the third passage the isolation was successful after 12 days and 13 days, which so far has been the maximum viability of K^1 in the animal body.

In the fourth and seventh passages 17 guinea pigs were used and 10 cultures made. Of these cultures only two were successful and in each instance the bacilli had been in the animal only 5 days. However, the passage cultures used in these experiments had been out of the animal body for several weeks before reinoculation into animals. From the seventh passage on to the thirteenth the cultures used for animal inoculation came from the previous passage. In the thirteenth passage the bacilli were recovered after 6 and 9 days residence in the animal but not after 12 and 14 days resepectively.

The local lesions produced by the injections as well as the internal organs have been closely examined. The extent of infiltration, the ulceration, the fibrosis and the enlargement of the lymph nodes were carefully recorded and are summarized below.

SUMMARY

1. The K^1 strain of tubercle bacilli has been passed through guinea pigs for 13 generations. The maximum viability in the animal body was 13 days, but viability cannot be taken alone as an index of increase of virulence. One must also consider the production of changes in the tissues.

2. As for the local reactions produced by the injections of K^1 in various passages, the bacilli from the ninth to the thirteenth passages produced more ulceration and enlargement of the local lymph nodes than the bacilli did in the earlier passages. In several guinea pigs of the ninth and thirteenth passages the lungs have shown a few miliary gray lesions which are not only macroscopically but also microscopically suspiciously like tubercles. These lesions are quite different from the patches which are seen in the lungs of normal guinea pigs.

3. The extent of the body reaction and the percentage of successful isolations do not seem to have much to do with the age or body weight of the guinea pigs.

4. In the cultural work the bacilli have shown no preference for serum or Petroff's media as compared with glycerol agar.

So far as stained preparations from the tissues and from the passage subcultures show the passage bacilli have not acquired any greater degree of acid-fastness.

SPECIFIC PURIFICATION OF ANTI-TUBERCULOSIS SERUM*

By Joseph D. Aronson, M.D.

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The fact that immune bodies can be precipitated from anti-pneumococcus serum by the addition thereto of an autolyzed extract of the specific antigen, has been demonstrated by Gay and Chickering. The work of Weinstein, Kosaki and Huntoon has corroborated the findings of Gay and Chickering.

An attempt was made by us to determine whether the immune bodies present in an anti-tuberculosis serum could be concentrated and purified by the addition of its specific antigen.

Method: An anti-tuberculosis serum was prepared by injecting a goat at irregular periods of time, with a living, avirulent culture of a strain of bovine bacillus. This serum, in the presence of its antigen, showed complement fixation in a quantity as small as .0001 cc. A number of different methods were used to prepare the precipitinogen.

A. Alcoholic extract of B. tuberculosis was prepared by extracting dry tubercle bacilli in a Soxhlet with boiling alcohol until all of the antigenic substance was removed.

B. Bacillary emulsions of B. tuberculosis were prepared by grinding the weighed mass of tubercle bacilli in an agate mortar for a long time and gradually adding salt solution, in order to bring it to the desired concentration.

C. Autolyzed extract of B. tuberculosis was prepared in the same manner as that used by Chickering in preparing his pneumococcus precipitinogen. Unlike the pneumococcus, the tubercle bacillus goes into solution but slightly, yielding a distinctly opalescent fluid.

D. A salt solution extract was prepared by boiling tubercle bacilli in salt solution for 15 minutes, centrifuging and using the clear fluid.

Removal of Immune Bodies: The immune bodies were removed by adding the antigen to the diluted serum, and, in the case of the alcoholic antigen, the diluted antigen was added to the serum. The mixture was then incubated for 2-4 hours, and in some experiments for 18 hours. No

* From the Henry Phipps Institute of the University of Pennsylvania, Philadelphia.

difference in results was noted when the antigen was added in one dose or in repeated smaller doses.

The addition of the antigen to the immune serum resulted in the production of a precipitate, the volume of the precipitate varying with the antigen used and being most marked when the alcoholic extract was employed.

The supernatant fluid was removed by centrifuging until clear, and the precipitate was washed 3-4 times with salt solution. Unless otherwise stated, the results given were obtained by the addition of alcoholic extract to the immune serum. It was soon found that the addition of the amount of antigen which theoretically should bring down all of the immune bodies, brought down but 60 per cent. of them, and it was not until 66 per cent. more than the theoretical amount of antigen had been added that all of the immune bodies were removed.

To determine the removal of immune bodies from the supernatant fluid, use was made of the complement fixation reaction, since the results obtained by means of agglutination and precipitation reactions are indefinite and not so sensitive as those obtained by means of complement fixation. No attempt was made in this work to determine the absence or presence of immune bodies having a protective value.

The determination of the presence or absence of immune bodies was made by adding two units of antigen and complement to the supernatant fluid, incubating for 2 hours, then adding a hemolytic system and incubating for 30 minutes more. The result was then read. The results obtained indicated that all of the complement fixing bodies could be removed by the addition of a sufficient quantity of antigen. In the course of this work we noted the fact that free antigen and complement fixing bodies could be demonstrated in an uncombined state in the supernatant fluid. This fact has also been noted by Linossier and Lemoine, by Eisenberg, and by Weil in reference to the presence of free precipitin and precipitinogen in a mixture of the two.

The removal of complement fixing bodies can be carried out also by using a bacillary emulsion or a bacillary extract prepared by boiling in salt solution, or by an autolyzed extract prepared according to the method of Chickering.

Specificity of Reaction: From our previous results in a study of complement fixation in tuberculosis, we found that with the exception of the B. lepra Duval and B. kedrowski, none of the acid fast bacteria at our disposal fixed an immune tuberculosis serum. In order to test further the question of the specific function of the antigen, we attempted to remove the immune bodies from the serum by the addition of a bacillary emulsion of B. rabinovitch (myc. lacticola phlei) to the immune serum which did not form a precipitate, and no removal of immune bodies from the supernatant fluid was demonstrable.

The addition of 95 per cent. alcohol in amount equal to the amount

of alcohol present in the alcoholic extract of the tubercle bacillus, did not remove any of the complement fixing bodies.

Dissociation of the Precipitate: The precipitate was washed in 3-4 changes of salt solution and the washings tested for the presence of free immune bodies. The first washing always showed a trace, but subsequent washings were generally free from immune bodies.

The liquid was carefully removed from the precipitate which was then treated in different ways to break up the antigen-antibody complex. For the purpose of dissociation, we made use of salt solution, distilled water, freezing and thawing, dialysis through a *collodion* sac, filtering through a Mandler filter, heating at 70° for 30-45 minutes, and weak sodium carbonate solution. The method consisted of adding to the precipitate, the various substances used as extractives; incubating for 2 to 4 hours of 42°C; centrifuging and testing the supernatant fluid for the presence of free antigen by the addition of free immune serum, and for the presence of free immune bodies by the addition of fresh antigen; adding complement to the tubes; incubating for 2 hours; adding a hemolytic system; and reading result within 30 minutes and again the next morning. Extracting with water or with salt solution yielded but 10 per cent. of the immune bodies, while .1 per cent. sodium carbonate yielded a 15 per cent. return by this method. Dialyzing the salt solution extract did not give a better yield than the undialyzed control. Freezing and thawing the extract in salt solution gave but a 6 per cent. yield of antibodies. Filtering the salt solution extract through a Mandler filter and adding charcoal to the extract removed both antigen and antibody from the extract. Heating to 70°C shows a marked destruction of the immune bodies and a liberation of the antigen.

By extracting the precipitate for a week or longer in dilute sodium carbonate in the ice box, we have succeeded in recovering 50 per cent. of the immune bodies in a free state. Neutralization of sodium carbonate extract with HCl does not cause a drop in this titre of the immune bodies. It is interesting to note in this connection that Weinstein, using an antiformin extract of B. typhosus and typhoid immune serum as the precipitin, succeeded in extracting about 5 per cent. of the agglutinins, 50 per cent. of the bactericidal bodies, and 10 per cent. of the complement fixing bodies.

Active Immunization with Precipitate: Rabbits immunized with the precipitate containing the antigen and antibody show a rapid production of immune bodies having a high titre.

SUMMARY

1. Immune bodies possessing the properties of amboceptor can be removed from their menstrum by means of their specific antigen.

2. The degree of completion of the removal of the immune bodies is

a quantitative one and is specific, and can be carried out without regard to the method of preparing the antigen.

3. Antigen and antibody can exist in an uncombined state.

4. Precipitate can be dissociated by treating with salt solution, water or a weak alkali, the latter yielding the best results especially after prolonged extraction.

5. Precipitate can produce active immunity.

6. Precipitate cannot be completely dissociated.

STUDIES ON THE BACTERIAL FLORA OF THE SPUTUM FROM CASES OF TUBERCULOSIS AND OTHER CHRONIC RESPIRATORY INFECTIONS*

By Caspar G. Burn

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The question of the significance of mixed infection in tuberculosis has been the subject of much debate in times past. It would serve no useful purpose to revive the argument at this time. Suffice to say that those whose views on the pathology of the disease are much under the influence of the results of animal experimentation are probably quite in accord to-day in so far as they recognize that the tubercle bacillus is entirely competent, unaided by other bacteria, to produce all of the characteristic phenomena of the disease; fever, caseous consolidation, and cavitation being those about which most question has arisen in the past. It is at least equally apparent that secondary infection when it exists may very greatly complicate the course of the disease, either clinically or in the anatomical sense. The exact significance of these complications may doubtless be determining in time, and the subject is worthy of further study at any time that precise methods of observation can be brought to bear upon it.

Problems of even greater importance, perhaps, are constantly arising in connection with the differential recognition of chronic non-tuberculous infections of the respiratory tract. Success in this field as in the other must depend on the continued, patient and discriminating application of the best bacteriological methods in association with careful clinical observation. The bacteriological work has in the past been especially unsatisfying.

We have, up to now concerned ourselves only with the results of the examination of the sputum. Review of the literature shows three distinct methods have been relied on, namely:

(1) Microscopic examination unaided by cultivations.
(2) Cultivation from the whole sputum as collected.
(3) Cultivation from the sputum after washing away the fluid portions, and the loosely attached bacteria associated with the more solid and insoluble parts.

The first two methods whether used separately or together are subject

* From the Eagleville Hospital, and the Henry Phipps Institute of the University of Pennsylvania, Philadelphia.

to obvious shortcomings which are well understood. The third method, that is the study of the washed sputum, has always seemed more likely to give truly representative results, and is the one whose merits we have been particularly concerned to examine. This method should in practice, always be complemented by microscopic and cultural examination of the unwashed sample.

In reviewing the literature pertaining to the technique of washing the sputum, we will find that there are two principal methods for washing the sputum, namely: (1) The "Koch-Kitasato" method, and (2) the mechanical method. The other methods of washing sputum are modifications of these two.

After having used the Kitasato[1] method of washing the sputum, we felt that it was not satisfactory for routine purposes. Then we constructed Harvey's[2] device for the mechanical washing of sputum and followed his directions as closely as possible, but had very little success with it, especially in the manipulation of the apparatus.

We then endeavored to devise an apparatus which might overcome the difficulties we had encountered, and yet keep the Harvey principle of rotating the sputum by a continuous flow of sterile water. The apparatus for washing which we developed consists of a two-liter flask of sterile water emptying by a siphon into a 50 cc. Erlenmeyer flask, through a tube of special design. The reservoir flask is placed several feet above the wash flask, proper union being effected by rubber tubing. The bent tube in the flask is so shaped and so placed that it ejects the water around the sides of the flask, and by this means a rotating stream is produced. The water passes off through the outlet as waste. The flask is adjusted so that the sputum particle is in the central portion of the stream of water and is, thereby, continuously agitated. The sputum particle may be washed for any desired period by constantly substituting a two-liter flask of sterile water as each preceding flask is emptied.

If the bacteriological examination of sputum is to be satisfactory, three main precautions must be taken. First, the sputum must be collected properly. The patient should gargle and wash his mouth thoroughly with sterile salt solution before expectorating into a sterile receptacle. This keeps down the number of mouth bacteria in the sample. In the study of tuberculosis, asthma, and bronchitis, it is necessary to obtain a representative sample of the sputum and not a specimen secreted from the nasopharyngeal region.

Second, the sputum must be studied immediately after it has been obtained. It has been shown by several investigators that B. influenza and the pneumococcus are not to be recovered from the sputum more than a short time after expectoration. Likewise, if the sample stands about the mouth bacteria tend to multiply, and the whole numerical relationship of the bacteria of the true sample also changes from hour to hour.

Third, the sputum must be thoroughly washed. The washing of the sputum is regarded as complete when cultures of the wash water on

plated blood agar and in plain bouillon remain sterile. If growth from the wash water is obtained it means that the loosely attached bacteria have not been entirely removed.

The routine method which we follow for the study of sputum is (1) to study stained smears of the direct sputum culture; (2) to make a direct culture from the unwashed sputum on blood agar plates and Sabaroud's agar, the purpose of the two procedures being to obtain a general idea of the micro-organisms present; (3) the washed sputum particle is so divided that one section may be inoculated on the surface of a blood agar plate, second section is inoculated in a blood bouillon tube from which blood agar plates are later poured according to Brown's technique[3] for the study of deep colonies of streptococcus, and the third section is planted on Sabaroud's Agar in order to obtain any yeasts or molds which may be present. In the case of suspected tuberculous sputum, a stained smear is examined for the presence of the tubercle bacillus.

Our studies were carried out during the early months of 1921, and the recent months of 1922. The specimens were obtained from 69 clinically positive tuberculous cases; 48 asthma cases considered to be of bacterial origin, and 16 other chronic non-tuberculous cases.

The study of 69 sputa of the tuberculous cases during the two years, showed that 28 per cent. of the sputa could be washed free of all bacteria except the tubercle bacillus, while the 48 sputa obtained from asthma cases and 16 sputa obtained from chronic non-tuberculous cases, always contained one or more residual types.

The tuberculous sputa which were not washed free from secondary invaders were studied from the point of view of the different types of bacteria that remained in the residue. During the early months of the year 1921, streptococcus non-hemolyticus (alpha type) were found in the greatest frequency (64 per cent.), while the hemolytic streptococci (beta type) were found in only 3 per cent. of the cases. The order of frequency of the other varieties for this period is as follows: diptheroids, staphylococci, M. catarrhalis, M. tetragenous, pneumococci, B. influenza and B. Friedlander.

During the winter of 1922, streptococcus non-hemolyticus (alpha type) was found with the greatest frequency (47 per cent.), while hemolytic streptococci were found in 18 per cent. of the cases, which is a considerable increase over the first year (1921).

During the first part of March, 1922, a number of hemorrhages occurred at one time among the patients in the Eagleville Hospital. This seemed to be associated with the increase of hemolytic streptococci. There were six cases of hemorrhage during this period of which five showed a hemolytic streptococcus in the washed sputum. The other hemorrhagic case showed a hemolytic streptococcus in the washed sputa three days later. The hemolytic streptococci were found at this time, as above stated, in 18 per cent. of the cases studied.

We then repeated the washing of the sputa from all the patients in the hospital at monthly intervals for three successive months. There was a gradual decrease of hemorrhages and a simultaneous, but slower decrease of the hemolytic streptococci, until the presence of hemorrhages were negative and the hemolytic streptococci occurred at the usual rate of frequency in such cases, namely 3 to 5 per cent.

An example of an interesting case showing the invasion of hemolytic streptococci is as follows: On January 30th, the sputum was washed free from all bacteria except the tubercle bacillus. On March 27th, the sputum was streaked with blood but the washed sputum did not show the presence of hemolytic streptococci until six days later when it was found in pure culture. On April 19th, the washing of the sputum was again repeated and the residue was washed free from every organism except the tubercle bacillus.

Molds or yeast were never found in the washed sputum of the tuberculous cases studied.

The frequency of the various types of organisms which remained in the washed sputa of the 48 asthma cases was as follows: Streptococcus non-hemolyticus occurred in 54 per cent. of the cases, while the hemolytic streptococcus (Beta Type) occurred in 6 per cent. of the cases. B. Friedlander, the next of frequency, occurred in 16 per cent. of the cases, while gram negative cocci, B. influenza, staphylococci, pneumococci, and diptheroids occurred in the order mentioned.

The frequency of the different types of bacteria that remained in the washed sputum of the 16 chronic non-tuberculous cases shows that streptococcus non-hemolyticus occurred in 68 per cent. of the cases and B. influenza in 62 per cent. of the cases, while the hemolytic streptococcus occurred in 12 per cent. of the cases and the other types of organisms in various order of frequency. One case showed the development on Sabaroud's Agar of a mould belonging to the aspergillus group. This case could not be secured for repeated examination.

In conclusion:

The washing of the sputum as we have used it seems adapted to continuous use as a routine method.

The residue after washing is fairly constant as to its bacterial content. Particularly yeasts, molds and the common bacteria of the air are practically eliminated from consideration. Whether significant bacteria are also washed away must for the present remain a matter of doubt.

The residual bacteria in tuberculosis, bacterial asthma and other chronic infections of the respiratory tract differ more in their percentage distribution within the clinical groups than in kind.

The freedom of almost one-third of the tuberculous cases from any other bacteria than the tubercle bacillus, the association of an increase of hemolytic streptococcus with epidemic hemorrhage in a group of tuberculosis cases and the higher percentage of influenza bacilli in the chronic infections other than tuberculosis and asthma during recent

months are perhaps the more significant of our observations with the method.

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SARANAC LAKE

CLINICAL AND X-RAY FINDINGS IN THE CHESTS OF NORMAL CHILDREN *

THE National Tuberculosis Association, some time ago, began a new and important phase of its work in an attempt to increase the quantity and character of research work in problems related to its own field in the United States. For this purpose it appropriated $20,000 and appointed a small committee composed of Dr. Wm. Charles White, Medical Director of the Tuberculosis League of Pittsburgh, Dr. Paul A. Lewis, Director of Laboratories of the Phipps Institute, Philadelphia, and Dr. Allen K. Krause, Director of the Kenneth Dows Tuberculosis Research Fund, Johns Hopkins Hospital, to expend these funds to the greatest advantage.

This committee decided that the best use of the funds would be in assisting researches already under way that held the greatest promise of increasing the practical knowledge of physicians dealing with tuberculosis. This, they considered, would bring the greatest help to those suffering from tuberculosis and the greatest boon to the public from whom the funds were collected. This plan has been carried out in coöperation with the universities.

One of the researches was an effort to establish the x-ray and clinical findings in the chest of the normal child up to ten years of age. For this problem the National Tuberculosis Association nominated the following groups of roentgenologists and clinicians:

Dr. H. K. Pancoast and Dr. H. R. M. Landis of the University of Pennsylvania.

Dr. F. H. Baetjer and Dr. C. R. Austrian of the Johns Hopkins University.

Dr. H. K. Dunham and Dr. K. D. Blackfan of the University of Cincinnati.

The signed reports of these physicians are here presented in two sections with the hope that they may promote a discussion which will be fruitful in establishing the truth in these two fields.

REPORT OF THE CLINICAL GROUP

The value of roentgenography in determining the presence of pulmonary disease has long been recognized. Studies to determine the roentgenograms of various pathological lesions of the lung have been almost

* A report of studies made under a grant of the Committee on Medical Research of the National Tuberculosis Association.

without number, yet much difference of opinion exists in the interpretation of findings, largely because no satisfactory observations have been made to establish the variations that may normally occur. To one observer, shadows noted are indicative of disease; to another, they are not evidence of a pathological process; to one, they represent lesions of clinical significance; to another, they suggest changes of no moment. Realization of this unsatisfactory state of affairs has been widespread, but it remained for the Research Committee of the National Tuberculosis Association seriously to consider it and to set about to correct its shortcomings.

In the spring of 1921, that Committee called together the collaborators in this work and instructed them to set about in ways of their own choosing to solve the problem, extended to them a financial grant and, in order that the problem might be a very definite one, asked that the immediate study be limited to a consideration of the chests of normal children between the ages of six and ten years. The work was begun promptly and a preliminary report was made at the annual meeting of the Association in May, 1921. The findings at that time were incomplete and because of the then limited observations, no very definite conclusions were drawn. However, the practical need of a solution of the problem was apparent. Study was continued throughout 1921 and the first four months of 1922, and the data independently assembled were jointly discussed to evaluate them. Although each pair of workers carried on its investigations without intergroup consultation, although each approached the subject from a different angle and when first met held views apparently not altogether in accord, it was agreeable to find that an exchange of conclusions disclosed almost an unanimity of opinion. The findings of these six observers, three clinicians and three roentgenologists, are herewith presented to you for your consideration.

Theoretically, the normal child is one of ideal height, weight and development for its age, without subjective or objective evidences of deformity or of disease and without residual changes due to antecedent pathological processes. Practically, a normal child is one of average height, weight and development for his age, symptom-free and without signs of disease. Each such individual, in more or less relation to his age, will have been ill more or less often and, as a consequence, may be expected to show variations from the ideal, not because of present disease, but as a result of residual changes that persist. An appreciation of these facts makes it apparent that the findings, clinical and roentgenographic, in normal children as we meet them will vary greatly from any fixed standards and still must be considered as variants of normal.

The clinical data dealt with in this report were obtained by careful examination of apparently healthy children between the ages of six and ten years. All children who showed signs of disease were excluded from the series. Individuals from various strata of society, foreign and native-born, residents of urban and of rural communities, school children and

children residing in institutions, children exposed to tuberculosis and some without a history of such exposure, children with and without a history of previous infectious diseases, all symptom-free and of an approximately normal height and weight for their ages, were studied. A history of each individual was recorded and in making the examinations of the chest, care was always observed to have the child relaxed and to see that no cramped or unnatural posture was assumed, for, as is well known, faulty position may lead to findings that cause confusion in interpretation. In addition, a tuberculin test was made on every child. The clinical data were then assembled and after the roentgenologist had interpreted his plate independently, the clinical and roentgenographic findings were correlated. In all, over 500 children were thus studied and as a result some definite conclusions seem warranted.

As in the adult, so in the child vocal fremitus is more marked over the right upper chest than over the left.

It is generally stated that the percussion note, elicited over the lungs of normal children within the age limits under consideration, is fuller, more tympanitic, of higher pitch and more resilient than that noted over those of adults, and that frequently the tympanitic quality is quite outspoken, especially over the lower lobe of the left lung. Although in general our observations confirmed this view, we have been impressed by the fact that in an appreciable number of such children, the note obtained on pecussion over the lungs is indistinguishable in quality from that elicited over the lungs of normal adults and that the usual resilience of the note is lacking. These findings in many instances have an analogue in shadows noted in the x-ray films, shadows indicative of increased density along the bronchial tree, similar to those seen in the plates of normal adults. This correlation of the findings on physical examination and on x-ray study is more constantly possible in studies of the upper half of the chest. When minor changes, similar to those discovered by x-ray examination of the upper lobes, occur in the bases, they usually escape detection on physical examination. In those instances in which no shadow is found to explain the deviation of the note from the generally accepted one, it is our belief that the lack of resilient quality may be due to a decreased elasticity of the chest wall.

The so called tympanitic quality of the percussion note over the left base may be increased, decreased or entirely lacking, depending upon the degree of distention of the stomach or colon, and the curvature of the spine, and may likewise vary with the position of the diaphragm or with the posture of the child during the examination. The note over the upper thorax is often the same on the two sides. Krönig's isthmus averages 5 to 6.5 cm. in width. The lower margins of the lungs posteriorly are at the level of the 10th or 11th rib and descend from 1.5 to 3.5 cm. during forced inspiration.

A just detectable diminution of resonance over the apical regions is

of no significance unless associated with a modification of the breath sounds in those areas or with other abnormal auscultatory findings.

It is generally accepted that normally in childhood the breath sounds have a harsh, sharper character, with expiration longer and better heard than in the normal adult. This so called puerile breathing is physiological and, though it may seem trite, let it be emphasized that this exaggerated vesiculobronchial respiratory murmur, especially well heard in the areas overlying the great bronchi (that is, anteriorly at the level of the first interspace and the second rib just lateral from the sternal margins, and posteriorly, particularly on the right side, at the level of the 2nd to the 4th spine) is often incorrectly interpreted as evidence of pulmonary disease. An auscultatory finding that has not been pointed out, or at least, has not been emphasized, has come forcibly to our attention in carrying out this study. Just as the full, deep note or higher pitch, characteristically elicited by percussion of the child's chest, is often replaced in health by a note more like that produced when one percusses the normal chest of an adult, so, on auscultation of a child's normal lungs, the exaggerated or puerile breath sounds may be lacking and, instead, the so called vesicular respiratory murmur characteristically present in adult life is heard. This finding, regarded by us as a physiological variation, has been noted as early as the age of four years and may perhaps occur in younger children. It is more readily appreciated and more often found than the variation in the percussion note just described. In more than 50 per cent. of the children in which this type of breathing was heard, examination with the x-ray gave findings like those obtained by a study of normal adult chests. In fact, the agreement of clinician and roentgenologist was so constant that we have come on the basis of these variations, to designate the chest of normal children as of "puerile" or of "adult" type. The essential fact to be stressed is that so called vesicular respiration is heard with great frequency in normal children, and is to be regarded as a variation of normal and not necessarily as an indication of disease.

These variations and those of the percussion note are more generally found in children with a history of infections of the respiratory tract. No satisfactory explanation for this finding is offered. It may be due in part to altered resilience of the chest wall, a suggestion supported by the fact that, in some instances in which it was noted, diminished elasticity of the thoracic wall was apparent on percussion. It may stand in relation to variations of elasticity of the parenchyma of the lung. It may be due to a relative narrowing of the lumen of the bronchial tree. It is hardly to be considered evidence of increased density of respiratory tissue, for, theoretically at least, this should lead to a modification toward bronchial breathing.

Concerning the whispered voice sounds, little comment needs to be made other than to emphasize their loud transmission often with syllabation over the region of the major bronchi. Auscultation of these sounds

over the upper thoracic spine of the children has led to the conclusion that D'Espine's sign, as indicative of enlarged tracheobronchial lymph nodes, is, to say the least, of doubtful value. In 23 of the children, this sign was elicited without other signs of a mediastinal mass and without any corroborative evidence on x-ray examination. In 3, the sign could not be elicited, although from the x-ray plate it might have been inferred that it should be. Eustace-Smith's sign is so generally present in normal children that it is of little or no practical diagnostic worth. The presence of these two signs, together with impairment of resonance in the interscapular region, is all too frequently made the premises for a diagnosis of tuberculosis of tracheobronchial lymph nodes. This is unwarranted for, as indicated, these signs are unreliable evidence of a pathological condition and the determination of a diminution of resonance in the interscapular region requires such a nicety of technique that even masters of percussion disagree as to the presence or absence of significant findings in this region of the chest.

A year ago, in the preliminary communication to this Association, we stressed the importance of the rôle that antecedent infections might play in the production of areas of increased density within the respiratory tract (bronchial tree, parenchyma of the lungs, etc.). This fact is reëmphasized, for further study has established the importance of it. Not only may recognized or remembered infections of the bronchi and lungs be responsible for alteration in these tissues, but other diseases not ordinarily considered of significance in this regard may cause such changes. For example, our observations indicate that after measles, pertussis or tonsillar infections, areas of increased density, radiating from the hilum into the bases especially, occur with great frequency. Such lesions generally are not discoverable on physical examination and would be unsuspected but for the use of the x-ray. They are referred to in the clinical part of our joint report in order to point out the need of a careful history as well as examination of all individuals, before proceeding finally to interpret the findings of the roentgenologist. By way of digression, it may be interesting to point out the fact that though measles and pertussis have been known to produce lesions in the upper air passages, involvement of the lower tract has been considered a complication and was thought to occur only when evidence of bronchitis or of bronchopneumonia was discovered. Our observations indicate that there may be a mild inflammatory process throughout the respiratory passages in a large percentage of the so called uncomplicated cases of these diseases. This suggestion warrants further study in relation not only to the infections under consideration but also other infectious diseases. That such shadows, mediastinal and basal, noted in children who give a history of uncomplicated measles and pertussis, are evidence of healed processes is indicated by the experience that similar shadows of like origin have remained unchanged and without the development of clinical symptoms in a series of children observed from three to five

years. Such changes must be properly evaluated as indices, not of present disease, but of lesions past and healed, not as warrant for the diagnosis of present illness and the institution of treatment, but as scars of infections met and overcome.

Most of the children included in this study were tested with tuberculin. Some were given a cutaneous test with old tuberculin (Pirquet); others were tested by the intracutaneous method (Craig).

The foregoing facts have been detailed at some length to establish the major thesis that, clinically, the ideal, normal child is a hypothetical impossibility. Children, apparently healthy, symptom-free and active, show on careful examination many deviations from fixed standards, variations that must be interpreted as within physiological limits; standards of height and weight must be elastic; measures of resonance and of resilience of the chest must not be rigid and estimates of acoustic phenomena must permit of a range of difference from the ideal. These facts clinical experience establishes beyond peradventure; and they suggest a corollary, namely, that x-ray examination of the chest of such children may be expected to show comparable deviations from a fixed ideal roentgenogram.

The studies reported, fortified by past experience, warrant the following conclusions:

1. The data obtained on percussion and auscultation of the lungs of normal children show wide variations from a fixed standard. These variations are usual and are considered to be within normal limits.

2. Inasmuch as the changes referred to are often dependent upon alterations that persist as the residua of past infections of the respiratory tract, it is obvious that a careful anamnesis, with special reference to all infections, is necessary if diagnostic errors are to be avoided. Even a carefully taken history is often unreliable, as minimal infections are soon forgotten by many, and among the unintelligent classes even more significant indispositions are not readily recalled.

3. Failure properly to evaluate these deviations from a fixed standard will often lead to the unwarranted diagnosis of disease and to even less justifiable treatment.

4. With a proper appreciation of the widest variations that the normal may present from the ideal, the informed clinician is better able correctly to understand the findings of the roentgenologist, and each, coöperating with the other, is less liable to error.

5. D'Espine's sign, as indicative of enlarged tracheobronchial lymph nodes, is of little value.

6. Recognition of and familiarity with the foregoing data are of cardinal and practical importance for every patient, potential and established. Without a proper appreciation of the facts set forth, no intelligent differentiation between a normal and an abnormal respiratory tract can be made.

In brief, to establish the presence or absence of disease, it is imperative that all data, clinical, laboratory and roentgenographic, must be evaluated and correlated, and that no one fraction of the evidence be stressed to the exclusion of the others.

(Signed) C. R. Austrian,
H. R. M. Landis,
Kenneth D. Blackfan.

May 6, 1922

REPORT OF THE X-RAY GROUP

It is generally conceded that one of the most important factors in accurate interpretation of the appearance of morbid processes in the roentgenogram of the thorax is a thorough familiarity with the normal and variations therefrom within normal limits. With a full realization of this in view the National Tuberculosis Association in 1921 appointed a committee, comprising three roentgenologists and three internists, to make a study of the normal chest of the child between the ages of six and ten years. This group was instructed to work in coöperation and to make a report of their investigations before the Association when their studies were completed and their conclusions reached. The members selected for the committee were Dr. H. Kennon Dunham of Cincinnati, Dr. Frederick H. Baetjer of Baltimore and Dr. Henry K. Pancoast of Philadelphia, to act in the capacity of roentgenologists and to work in coöperation with the respective internists in the same cities, Dr. Kenneth Blackfan, Dr. Charles R. Austrian and Dr. H. R. M. Landis. Each group of two was to work independently until a satisfactory number of individuals were examined and the entire committee was then to meet and draw their conclusions for presentation. It was to be the duty of the internist in each group, by careful clinical study, to select as nearly normal children as possible for examination by the roentgenologist. The entire procedure was to be carried out with strict coöperation between the two members of each group.

It was soon realized by the members of the x-ray group that an attempt to describe a normal chest was practically impossible. Their endeavors soon began to center around the description of a theoretical normal with wide variations that would serve as a basis for the interpretation of abnormal appearances and tend to preclude the possibility of erroneous diagnosis being based upon faulty interpretations of hilum shadows, trunk shadows and linear markings, more or less altered in appearance by the frequent respiratory infections of childhood. They realized that herein had existed the greatest source of error in interpretation, and no doubt the Research Committee of the Association had this same thought in mind when the committee was appointed to take up these investigations. Errors in interpretation have been made chiefly in connection with the diagnosis of pulmonary tuberculosis.

It was the consensus of opinion that children are probably more apt than adults to show definite x-ray evidences in the hilum and trunk shadows of simple as well as serious respiratory infections. Practically all children of the ages of those examined have had at one time or another one or more respiratory infections, especially measles and whooping cough, that are likely to produce very apparent changes in the shadows mentioned and which will remain distinctly visible for a variable period of time. These apparent deviations from the normal are not necessarily abnormal when observed, but may be the harmless results of one or more infections. No doubt such appearances have many times been misinterpreted as evidences of tuberculosis. In the conclusions reached by the committee the attempt has been made to preclude this possibility.

Many of the general observations made have not been included in the conclusions. One of those perhaps worth mentioning is the fact that the heart of the child is found to extend relatively further to the right than in the adult.

The thoroughness with which the studies were carried out may be in part realized from the number of invididuals examined. Over five hundred children were selected from all strata of life, as stated in the clinical report of the committee.

The groups comprising the committee met at the Phipps Institute, Philadelphia, March 3, 1922. Prior to this meeting there were misgivings as to the possibility of an agreement upon any very definite conclusions, but much to the satisfaction of all the members a definite agreement was reached and the conclusions were completed after a few hours' deliberation.

To assist in a better understanding of the conclusions of the committee, a composite diagrammatic reproduction of several roentgenograms was made and is shown in the accompanying illustration.* It must be remembered that the three zones like the chest have thickness as well as length and breadth. Thus the zones extend anteriorly and posteriorly from the lung root as well as laterally.

Conclusions of the X-ray Division of the Committee

The normal chest. The normal chest of the child from the roentgenological standpoint is subject to such wide variations within normal limits as to be beyond the possibility of exact description.

Hilum shadow. The conglomerate shadow, commonly called the hilum shadow, when found lying entirely within the inner third or zone of the lung area can be disregarded (or regarded as normal), except where it is made up of a solid mass of homogeneous shadow giving undoubted evidence that it represents a growth or mediastinal pleurisy.

* This illustration may be found facing page 340 in the July issue of the American Review of Tuberculosis.

Calcified nodes. Calcified nodes at the root of the lung, without evidence of lung disease, are of no significance except as a possible evidence of some healed inflammatory condition, possibly but not necessarily tuberculous. They are a common finding in normal chests.

Density and thickness of trunk shadows. In the normal lung the bronchial trunk shadows are not visible in the extreme apical regions. For convenience of description the remainder of the lung is divided into three vertical zones, extending outward from the lateral border of the spinal shadow to the lateral chest border.

The inner zone contains the root shadows.

The middle zone contains the trunk shadows, gradually fading out into their final subdivisions.

The peripheral zone contains radiating lines from these and fading off before the periphery is reached.

Where, in the middle zone or peripheral zone, these shadows do not disappear in the characteristic fashion described, the appearance may be evidence of a variety of conditions, past or present, of an inflammatory nature or otherwise. It may accompany a tuberculous process but is not necessarily indicative of tuberculosis.

Improper or misleading terms. The use of the terms "peribronchial tuberculosis" and "parenchymatous tuberculosis" is not to be recommended in the interpretation of roentgenograms of the chest. Until corroborated by laboratory or clinical findings, the use of the terms "active" and "quiescent" should not be definitely applied to evident lesions demonstrated on plates.

(Signed) HENRY K. PANCOAST,
KENNON DUNHAM,
F. H. BAETJER.

May 6, 1922.

The Chairman: You have heard the report of the two sections of the committee. I should like to ask Dr. White if he will say a few words before the paper is thrown open for general discussion.

Dr. William Charles White, Pittsburgh: Dr. Austrian has asked me to say to you a word or two of the program for the coming year, but first I want to express the appreciation of this Association, through this Committee, for the spirit which has activated the various men who have worked not only in this x-ray group but also in the three researches which the National Association has recognized. It could not have been finer, and, as you have heard from these two reports, it could not have been better.

The attempt to get a normal standard from which our readings can follow in the diagnosis and thereafter the treatment of cases suffering from tuberculosis has been an essential long necessary in this work. It is the expression, too, of the greatest help that this Association can render to the public which entrusts it from year to year with funds for expendi-

ture in the prevention of this disease, and as Chairman of the Committee I feel especially deeply the interest and results of the work which these men have done. The other members of the Committee, Dr. Lewis and Dr. Krause, feel exactly the same way.

For the coming year it has been decided on the advice of those who have presented these two reports just now, that the same task be performed for the normal adult chest.

The most striking thing to me, in listening to the discussions at the Philadelphia meeting in the Phipps Institute, was that from all the children examined there was only one without a history of illness of some sort and without signs in the chest; so that that will indicate to you how difficult it has been to present more than a hypothetical normal with the wide variation of which both Dr. Austrian and Dr. Pancoast, representing the Committee, have spoken.

For this past year these men have agreed, and with an expression that was very gratifying, that they had never done a more interesting thing to establish the normal for the childhood period.

The second two fields which it has been decided to support are Dr. Miller's work—and right here, if I may do so I should like to express the sadness of this Association that Dr. Miller, owing to a long period of illness, has been unable to present his studies to the Association. As you know, his studies are on the blood supply, the lymph supply, and the lymph glandular structure of the lungs, which have never yet been fully worked out. Dr. Miller's request for a continuation of support has been granted by the Committee of this year.

Dr. Long has had a most productive year's work, along with his assistants and Professor Treat Johnson of Yale, on the essential factors in the biology of the tubercle bacillus. Dr. Long will present his paper this afternoon, and Dr. Long has presented the program for the further study of tuberculosis in our knowledge of the essential factors in the tubercle bacillus of man.

Dr. Walker, who has been settling the curious situation that has arisen before the Association with regard to chaulmoogra oil, will present his final conclusions today and is not ready to present the evidence of where the avenues will lead, coming out of his work.

A third problem, which has been giving the Committee very serious concern during the past few months is that relating to dust and tuberculosis and the human lungs. It is also hoped that some plan for completing or improving our knowledge on this question and putting it upon a sound scientific basis will be ready for presentation at the meeting next year.

The Chairman: The report of the Committee is now open for discussion.

In throwing the papers open for general discussion I should like to ask that it be borne in mind that the discussion is one

of the normal and that we are not discussing the question of the findings in tuberculosis roentgenographically, except in so far as there may be confusion with the normal picture. The papers are now open for general discussion.

DISCUSSION ON X-RAY AND CLINICAL FINDINGS IN THE CHESTS OF NORMAL CHILDREN

Dr. Alexius M. Forster, Colorado Springs: I want to say a word about the clinical report. To those of us who have made any study of this subject and who have consulted the various articles in the literature with their loose and uncertain terms, this report comes like a breath of fresh air. I am only sorry that the Committee did not report their observations in regard to the dimensions of the child's chest, because I think that that certainly has some bearing on the subject. I have no doubt that possibly in the body of the report that subject, along with percussion, auscultation and palpation, was considered, but I think it would be very well if that were published with their other observations, because I think that textbooks do not call attention to the fact that in considering the dimensions of the chest, whether the child or adult, you should include not only length and breadth but also depth, and while it is a simple thing, you get a very much better idea about your chest if you do remember that the chest has three dimensions.

Dr. Wallace J. Durel, New Orleans: Just a word of congratulation to this Committee. For years we have been deceived and led to erroneous conclusions by accepting certain diagnostic measures which alone were not sufficient in determining the normal factor of the lung of the the child. At last we have come to the conclusion that no special or separate diagnostic finding will determine this factor. For that alone, I feel sufficiently rewarded in making the trip from New Orleans to this meeting.

I think that the conclusions of this Committee evince the greatest progress that we have made in our medical section, and show in a frank and unbiassed way that it is neither the x-ray, nor the clinical and physical findings, nor the laboratory and tuberculin findings, nor any one special finding—but a combination and study of all these factors that will determine the exact condition of the individual.

Dr. George M. Kober, Washington: I think that we feel a debt of gratitude to the Committee on Medical Research for the very able reports presented, which are epoch making in the history of the Association, and if this meeting had been held yesterday I should have taken occasion as Chairman of the Committee on Resolutions to offer a formal resolution before the general meeting. I want to express my deep personal appreciation of the work done, and I am very sure that the work

still to be done in relation to the determination of the different variations in the adult will be of the utmost practical and scientific value.

Dr. Edward O. Otis, Boston: I simply want to express to these gentlemen composing the Committee my appreciation of the work they have done and my satisfaction with their results.

The diagnosis of active pulmonary tuberculosis in children is in many cases, as we know, admittedly difficult, and one of the difficulties in making the diagnosis has been the uncertainty in the x-ray interpretation. This Committee has now given us a standard x-ray picture thus enabling us to draw more definite conclusions than we have been able to before. Their work means a definite advance in the diagnostic methods of childhood tuberculosis.

Dr. H. L. Barnes, Wallum Lake, R. I.: I should like to inquire whether there was any observation made on the normal children in regard to the lymph nodes before and after attacks of whooping cough and measles? It has occurred to me that a school of young children could be x-rayed and those pupils who later developed measles or whooping cough, again radiographed and comparison of plates made. Cooperation with a contagious disease hospital having good x-ray equipment would be necessary. Such a study should be helpful as the question of how much, if any, recent contagious diseases have changed the lung picture is an issue in the diagnosis of many doubtful cases in children.

I saw three cases of measles last year and I happened to x-ray these children just before the attack and again just after the attack, and I was unable to see in those three cases that the measles in any way affected the lung picture.

Dr. L. S. B. Robinson, Ft. Bayard, N. M.: I am prompted by the last speaker's remarks to present two cases belonging to my own family. Three years ago last January, my two boys, aged at that time four and a half and six years, had presumably influenza. Six months later they both had radiograms of the chest made by and read by very expert men, and it looked very alarming. The younger child particularly had what was reported as fibrosis throughout both lungs. Of course, it was fibrosis, not active tuberculosis. The other boy had two or three little spots, a little larger than a pinhead, that might be regarded as calcified glands. I was encouraged by the assurance that both children showed wonderful resistance.

Two years later, last July, they were both x-rayed and the plates read by one of the two men who read them first. Both plates were absolutely clear, with the exception of the very slightest bit of fibrosis around the hilus region, the least that we could expect to see in any child's chest, I think, and a couple of spots in one of them about the size of a pinhead. Evidently something that might have readily been regarded as serious disease and something permanent had completely cleared up.

The Chairman: Is there any further discussion? Dr. Baetjer.

Dr. F. H. Baetjer, Baltimore: I see hardly any necessity for my talking. The report has been so ably presented and I haven't found anybody to fight with, in fact, I am rather disappointed. My experience has been that when a paper is presented on the average piece of work that is done and everybody gets up and praises it, it is pretty rotten. On the other hand, when everybody criticizes, it means that you have stepped on somebody's pet hobby or theory and there must have been something in it.

I must confess two years ago I entered this work with a certain amount of reluctance, and it has almost become my pet baby now, and that is the reason I feel badly because no one has jumped on it, because I would like to get up and fight for it. There is one thing I would like to say since we have given you a sort of diagrammatic chest, that we hope in looking at plates in the future you will begin to study them from that standpoint. Please remember that this does not apply to adults; that the interpretation of chests of children is totally different from that of adults.

I remember the time when we had no Children's Department in the hospital that I am connected with, and when the Children's Department was finally opened we started in interpreting the chests of children absolutely along the same basis and giving the same values to the shadows that would be seen in an adult. We found the value of that diagnosis was something like six-tenths of one per cent. We had to recast our ideas completely. I am giving you that because I feel, so far as we have gone with the work today, we have really not touched upon the big and important problem yet, and that is the adults.

The hypothetical lung, as has been pointed out to you, does not exist. We have made plates of children born in the maternity ward in the hospital with which I am connected, and in practically every one of these cases we have found a tremendous amount of infiltration. As you know, we have an Embryological Department there, under the direction of the Carnegie Institute, and we have even found lung infiltration in these embryos.

In regard to Dr. Barnes' question, we were confronted with that same difficulty in doing this work. We felt, in the first place, for a final checking up we had to take the clinical side, which we felt was not as satisfactory as it might be and we were very anxious to get autopsies, but we could not get patients who we felt were killed by accident in whom the lungs were involved and at the same time might be normal.

There were a number of children, where we have had definite history of tuberculosis, especially in influenza. I have one case in mind: The child of a colleague of mine, where there was a consolidation at one of the bases a trifle larger than a quarter. That consolidation persisted for a period of nine months before it completely disappeared, and during that period of time the child would have exacerbations of fever and symptoms. I have followed the lungs of a classmate of mine and a colleague of mine, following influenza; an exacerbation has persisted for three years.

When you get a child's lungs which are filled with a general fibrosis, you can generally feel pretty comfortable that it isn't tuberculosis. The only time you see tuberculosis in which an entire lung is hit in a symmetrical manner is when you have an acute miliary tuberculosis; but when you get this so-called fibroid tuberculosis, you will find it is almost invariably confined to one portion of the lung, and outside of children it is generally in the upper portion of the lung. When you have a fibrosis equally distributed, the chances are eight to one that you haven't tuberculosis, and you don't need to worry about that.

THE PYRIMIDINES OF THE TUBERCLE BACILLUS*

By Treat B. Johnson, Ph.D. and E. B. Brown

New Haven

AND

Esmond R. Long, Ph.D.

Chicago

It may be recalled that at the meeting last year I referred to a piece of research on the pyrimidine bases of the tubercle bacillus which was to be conducted at Yale University under the direction of Dr. Johnson, to be financed through funds placed in our care by this Association. The investigation had two objects in view. One was to furnish another check on the amount of nucleic acid present in tubercle bacilli, pyrimidines being characteristic constituents of nucleic acid. The other was nothing less than to locate the tubercle bacillus phylogenetically, as a plant or an animal.

Let us illustrate what is meant by a brief review of the chemistry of nucleic acid, which has been well worked out by the labors of Kossel, Jones, Levene and others. There appear to be two kinds of nucleic acid. One is found characteristically in animal tissues. It has been most extensively studied in the thymus gland and pancreas. The other is found in plant tissues, yeast and wheat acids being the ones most studied. The skeleton of these acids is the same. Each one consists of phosphoric acid in combination with certain sugars, which are in turn combined with basic substances characteristic of nucleic acid, purines and pyrimidines. The sugars differ in the two kinds, hexose occurring in the animal acid, and pentose in the plant variety. The purine bases are the same in both, adenine and guanine. There is a variation in the pyrimidine content, however. Both acids contain cytosine, but the animal acid contains thymine and no uracil, while the plant acid contains uracil but no thymine.

Although it has long been known that a nucleic acid was present in the tubercle bacillus, most of the investigations on the amount present have been very inaccurate. Phosphorus has usually been taken as an index of the quantity present, but the work of Johnson and Brown has shown that in defatted bacilli there is more phosphorus outside of the nucleic acid than in it. Two years ago Long used the purine bases as an index

* Work being done under grant of the Committee on Medical Research of the National Tuberculosis Association.

for the nucleic acid present and calculated that it could not exceed two or three per cent., a value much lower than had been assumed on the basis of phosphorus estimations.

Pyrimidine analyses have been few and have suffered until the present from the lack of good methods. Kitashima, Behring, and Ruppel believed thymine was present, but did not definitely distinguish it from uracil. Levene isolated a small amount of substance which he believed to be a mixture of thymine, uracil and cytosine. Limitations in method and material available prevented him from being sure, however. We may say without fear of contradiction that the only accurate pyrimidine investigation of the tubercle bacillus ever conducted is that which has recently been carried to success by Johnson and Brown, who used a kilogram of dry bacilli.

The material for this study was courteously furnished by Parke, Davis and Company, and Mulford and Company. It consisted of a mixture of human and bovine type bacilli. Johnson and Brown defatted this material with toluene and alcohol and extracted nucleic acid from the residue with sodium hydrate. The yield was from one to one and a half per cent., confirmatory evidence that the value calculated by Long from purine figures was not too low. This was hydrolyzed with acid and tested for pyrimidines by the delicate color methods of Johnson and Bandisch. Thymine and cytosine were found to be present while no test for uracil could be obtained. From the bulk of material actual isolation of pyrimidines was then carried out by complex methods which we shall not describe. Complete agreement with the color tests was obtained. Thymine and cytosine were isolated in pure form in amount sufficient for analysis. Uracil was absent. These findings prove that the nucleic acid of the tubercle bacillus is definitely of the animal, not of the plant type.

THE CARBON METABOLISM OF THE TUBERCLE BACILLUS*

By Esmond R. Long, Ph.D., Leo K. Campbell and Agatha Major Smith

Chicago

In carbon, nitrogen and phosporus we have three esential elements of protoplasm the metabolism of which may be readily followed. As they exist in living matter they are always in combination with certain other elements without which life could not endure, notably hydrogen and oxygen. When we add to these certain ions commonly considered inorganic such as potassium, sodium, calcium and chlorine, our list covering the minimum requirements for the maintenance of life may be considered complete.

Now much may be learned of the processes concerned in carrying on life in an organism by a study of its carbon and nitrogen metabolism. Measurement of the utilization of these elements means much from this point of view. Changes in the hydrogen and oxygen content are of great significance too, but less readily measurable, for the greater part of the hydrogen and oxygen present is in the form of water, indispensable as a solvent and as a means of giving form and consistency to protoplasm, but not to be considered a food stuff in the sense that it may be metabolized.

It so happens that in the building stones of living matter, carbon is frequently acidic in character, or at least has a characteristic association with acids, while nitrogen has a similiar characteristic association with basicity. And yet as we see living matter, in which these two fundamental elements are present, we find it practically neutral. On closer examination, however, we find that in maintenance of this neutrality a considerable interplay of acidity and alkalinity is concerned. The great building stones of the fundamental constitutent of life, protein, the amino acids, are essentially combinations of the basic substance ammonia and organic, that is to say, carbonaceous, acids. And in the metabolism of this substance, protein, a stream of associations and dissociations of these two units is constantly being carried on. When we add that the alkalinity of ammonia can be neutralized only by some form of combination with acids, while the acidity of an acid may be rendered ineffective either by a similiar means; viz, combination with an alkali, or by the

* Work being done under grant of the Committee on Medical Research of the National Tuberculosis Association.

destructive process of oxidation and attendant production of energy, we see that close observation of acid and alkaline changes may give much information as to the type of metabolism taking place.

But if living matter is kept in a state of constant approximate neutrality how are we to learn anything of this interplay of acidic and basic substances? There are many ways, varying with the complexity and state of organization of the cellular material studied. We are particularly concerned at present with micro-organisms, and we may say at once that the best way of following these changes lies in a study of the medium of their growth, in which these changes are reflected. It is, of course, common knowledge that conspicuous changes in the direction of alkalinity or acidity may take place in culture media. These may be summarized as follows: The development of acidity means the occurrence of one of these events: the addition of an acid substance by the growing material, or the withdrawal of an alkaline one. Change in the alkaline

Table 1

Relation of nitrogen and phosphorus utilization to reaction change in growth of dung bacillus.

Medium contains glycerol and ammonium phosphate (Mixture of $(NH_4)_2HPO_4$ and $NH_4H_2PO_4$)

Culture number	Acidity in terms of c. c. N NaOH / 10	P content in mg	P loss in mg	P loss in c. c. N H_3PO_4 / 10	NH_3 content in mg	NH_3 loss in mg	NH_3 loss in c. c. N NH_4OH / 10
Control	0	84.6	0	0	58.4	0	0
1 (one crop)	18.5	80.0	4.6	1.5	43.5	14.9	8.7
2 (one crop)	18.5	80.3	4.3	1.4	44.2	14.2	8.3
3 (three crops)	40.0	76.4	8.2	2.7	19.0	39.4	23.1

direction means the reverse of these factors. Let me illustrate the character of these changes by a simple example:

In this table (table 1) you see what has occurred in a simple medium consisting essentially of an aqueous solution of ammonium phosphate and glycerol. You will note that we start out with four flasks all the same at the outset containing each exactly 84.6 mg. of phosphorus and 58.4 mg. of ammonia. Three of these are inoculated with the dung bacillus, an acid-fast micro-organism of the grass bacillus type. Of these three cultures two are subjected to analysis as soon as growth has covered the surface and stopped. We find that a considerable acidity

has developed, 18.5 cc. of tenth normal alkali being required to restore the medium to its original neutrality. At the same time we note that both phosphorus and nitrogen have been withdrawn, the latter however more rapidly than the former. In the other flask a much greater growth was secured by the simple method of shaking the floating organisms down as soon as stoppage of growth occurred, neutralizing the inhibitory acidity by aseptic addition of alkali, and allowing growth to proceed again from the bits of seed still floating. In this way three cultivations were carried on in the course of a month, and a total weight of about three grams of moist bacilli secured. You will note that in all 40 cc. of tenth normal sodium hydrate were required to maintain or restore neutrality. The loss of phosphorus and ammonia is greater than in the one crop cultivations, as would naturally be expected, and in about the same proportion, the ammonia being withdrawn much more rapidly than the phosphorus, as is seen when they are measured in terms of cc. of the base and the acid in which they occur; viz., ammonium hydroxide and phosphoric acid. As we may be sure that neither one of these compounds has been lost to the air in appreciable amount, we know that the nitrogen and phosphorus thus lost have become constituents in the same proportion in the growing bacilli. Such a disproportion in the rate of withdrawal, the alkaline substance being withdrawn much more rapidly than the acid one, must mean a corresponding development of acidity in the medium, from the phosphoric acid left behind. And we have seen that the medium did indeed become acid. But does the phosphoric acid residue left after withdrawal of ammonia from the ammonium phosphate combination represent the total of the acidity developed? By no means. It accounts not for 40 cc., the total acidity developed, but for approximately 23.1 minus 2.7 cc., or 20.4 cc., or about half. I say approximately because it must be remembered that tenth normal phosphoric acid and tenth normal ammonia are not exact equivalents as respects phenolsulphone phthalein, the indicator used. However, about, if not exactly, 20 cc. of tenth normal acid has arrived from another source. That source is obviously the glycerol, from which acids are produced by oxidation. And now if it is asked how it is that neutrality is maintained in the living bacilli when such an excess of alkali as indicated has been withdrawn from the ammonium phosphate, I am at once able to respond that it is by neutralization of that alkali by acids produced from the glycerol, acids in addition, too, to the 20 cc. or so of tenth normal acid I have just referred to, which are found in the medium. In the living organism the ammonia and glycerol-derived acids have been combined by undoubtedly very complex processes to form amino acids, acid amides and nitrogenous fat-like substances, which are neutral compounds. And so in this very simple experiment we have learned a good deal about food utilization by this bacillus.

Let me now describe briefly a rapid method by which reaction changes may be followed in a rough way with minimum effort in culture media.

It is a modification of one I reported last year. A glycerol agar medium containing 5 per cent. glycerol, 1 per cent. peptone, 2 per cent. agar and ½ per cent. salt, is prepared with the addition of 150 cc. of 0.01 per cent. phenolsulphonephthalein solution to each liter. The reaction is adjusted to a hydrogen ion concentration of pH 7.0 by direct addition of alkali, comparison with a standard known to be pH 7.0 being made in the comparator shown in the slide. You will note that a tube of identical medium, minus the indicator, is provided, to be placed in back of the clear standards. The colored medium is tubed in 10 cc. amounts and sterilized and allowed to solidify in the usual way. The reaction is again read in the comparator, as it may have changed some in the autoclaving. The tubes are now ready to be seeded with any sort of organism. Reaction changes as they develop in the course of growth day by day or week by week may be easily read off by comparing the tubes with standards in the comparator. A few tubes in which distinct reaction changes have taken place are shown in the slide.

Of course, solid media containing all sorts of nutrients besides peptone and glycerol can be similarly prepared. We have made many containing only an ammonium salt of an organic acid or an amino acid or acid amide, or one of these compounds plus glycerol. I shall now show you the reaction changes occurring in some of these media in the course of growth of a variety of micro-organisms. In this slide you will see that on a medium containing acetamide only as metabolizable material, smegma, grass, mist, timothy, fish, turtle, frog and avian bacilli all leave the medium alkaline. This can only mean that carbon is being used more rapidly than nitrogen, either by synthesis into compounds containing more carbon as compared with nitrogen than acetamide, or by combustion to carbonic acid, the acidity of which is almost negligible. As may be seen from the next slides, a final alkalinity results not only when acid amides, such as acetamide are used but also when amino acids, such as alanine, and ammonium salts, such as ammonium propionate, are used. Almost uniformly the acid element, the carbonaceous, that is, is used up more rapidly than the basic element, the nitrogen. If now we change the conditions by putting in another source of acid, such as glycerol, which, as you saw a few moments ago, produced much acid in the metabolism of the dung bacillus, we may not have such a marked development of alkalinity. We may have approximate neutrality remaining, or even the development of acidity.

Unfortunately, I have no slide showing this change on addition of glycerol, although I have in my incubator running at present a series of the same bacilli on an acetamide medium, illustrating the proposition perfectly. However, I have here a slide illustrating the double tendency when a tubercle bacillus is grown upon an acetamide-glycerol medium. You will note that just as in the well known Theobald Smith curve an initial alkalinity develops, followed by an acidity. You will note too that the human type and bovine type bacilli used act about the same. I am not one of those who believe that in particular cases these two types of

virulent bacilli can be distinguished by this means. I have too many organisms of the bovine type which are good acid producers. In fact, as you will see from the next slide, cultures of the same organism run on identical media simultaneously may vary tremendously in reaction. Here is represented growth of a bovine type organism on two tubes of a medium containing acetamide and glycerol. In one case a marked alkalinity is produced; in the other a marked, progressive acidity. All that the last three slides illustrate is the double tendency, when both acetamide and glycerol are present. When the acetamide alone is supplied, alkalinity, almost invariable, occurs. Put in glycerol and the result cannot be predicted. The final reaction may be acid, alkaline or neutral. Which will run ahead, acidity or alkalinity, depends on certain unknown factors, factors which must vary not only with strains of micro-organism, but even with individual bacilli of the same strain. This extraordinary variability is discouraging to all but the evolutionists, but is nothing new in the science of bacteriology.

Thus far we have perhaps shown that in the metabolism of bacilli of the acid fast group glycerol is an acid producer, furnishing acid at something in excess of the rate required to neutralize absorbed ammonia in the construction of neutral protoplasm. This proposition apparently holds good for all of the acid fast group. It remains now to inquire what is the essential difference between virulent and avirulent organisms which renders glycerol so nearly necessary to the tubercle bacillus while the saprophytes get along equally well on other sources of carbon. Nutritional studies have so far failed to yield us the desired information, as we have not yet identified the acids produced by the respective groups in glycerol metabolism. Perhaps the information may never be obtained by this method, as the culture medium tells us only what is excreted or left behind, and furnishes no information as to the manner in which the metabolites are being combined or burned up within the bacterial cell.

By an indirect method, however, which skips many tedious steps, we gain some of the desired information. This method is comparative analysis of the finished product, the grown organism. It so happens that recently a French investigator, Frouin, compared the composition of tubercle bacilli grown upon two sets of media, one containing glycerol, the other no glycerol, but 15 per cent. glucose in its place. He found that growth was not nearly so good upon the latter medium, and furthermore that the bacilli grown upon it did not have the same composition as the others. They were distinctly less fatty. On the average the amount of material extractable from them by fat solvents was about one-third that obtained from the glycerol-grown bacilli. This finding, while not startling or unexpected, is none the less significant. It shows that it is the glycerol which builds the so-called fats of the bacillus. This would be no cause for comment if the so-called fats of the bacillus were real fat, of which glycerol is a constant constituent. But, as will be shown in a moment, most of it is not fat at all, but wax, which contains no glycerol.

The next slide (table 2) shows the lipin content of a number of

acid fast bacilli. When one says lipin content, he should specify the method of extraction used. Our method was two boilings in absolute alcohol followed by thorough leaching with petrolem ether. The alcohol extracts were evaporated to dryness and extracted with petroleum ether. The petroleum ether extracts were added together. The final figure is thus the per cent. of the dry weight which is soluble in medium boiling petroleum ether. It does not include a certain amount of lipoid known to be more firmly bound in the bacillary body, nor does it include a fairly large amount of material soluble in hot alcohol and insoluble in petroleum ether. It really represents a kind of storehouse fat laid up by the organism. Its removal leaves the latter still completely acid-fast. As you will see, the organisms of this group are unusually rich in lipin. With the exception of an avian type bacillus and a leprosy bacillus which contained some twenty-five per cent. of their dry weight in a form soluble in

TABLE 2

Lipin Content of Acid-fast Bacilli

	Total lipin in per cent. of dry weight	Saponification number	Per cent. of total lipins as non-saponifiable lipoid
H 37—Human type tubercle bacillus.	22.7	131	77.1
B 1—Bovine type tubercle bacillus...	22.3	139	60.0
A 1—Avian type tubercle bacillus....	11.0	194	35.7
Leprosy bacillus Duval.....	9.7	188	27.2
Turtle bacillus.....	36.3	191	28.3
Frog bacillus.....	37.1	195	33.7
Smegma bacillus.....	35.6	128	4.6
Dung bacillus.....	34.7	125	5.4
Grass bacillus	23.4	147	9.4
Grass III bacillus.....	20.3	109	4.5
Timothy bacillus.....	20.2	—	—

hot alcohol but insoluble in petroleum ether, they run above 20 per cent., sometimes almost 40 per cent. lipin. Now acid-fast organisms analyzed by the same method showed not over 5 per cent lipin. A point of fully as great interest, however, is the great difference shown in the nature of the fatty material extracted. The figure for non-saponifiable lipoids is a measure of the wax content. Substances which are known to be esters of fatty acids and alcohols of high molecular weight are much more difficult to saponify with alkali than esters of fatty acids and glycerol. Our figures indicate that the virulent organisms at one end of the column are conspicuous for their high wax content, 60 to nearly 80 per cent., while the saprophytes at the other end of the column are conspicuous for their low content, 5 to 10 per cent. In between come the organisms of questionable virulence with a wax percentage of 25 to 30 per cent. Now we do not wish to draw too sweeping conclusions from these figures. It might be suggested that these bacilli acted as persistent foreign bodies in tissues in direct proportion to their content of this highly indigestible wax. But we would like to show that by experiment first. What we do feel permitted to say is that the organisms for which glycerol is almost a necessity are very high in wax. Those which use it, but can get along without it, are exceptionally low in it. Their lipin is of a soft greasy character, presumably most of it true fat. In addition to these is a group of organisms which in our experience are decidedly glycerophilic, and yet will thrive without glycerol if necessary and which, as reported at the Association's meeting last year, nutritionally constitute a group distinct from the tubercle bacilli on the one hand and the smegma and grass bacilli on the other. With these facts at hand, we feel that we have sound experimental evidence for believing what has been vaguely suspected for some time; viz., that glycerol is not a fat builder, but a wax progenitor.

The Chairman: The next contribution is, "Second Progress Report on the Investigation of the Chemotherapeutics of Chaulmoogra Oil and its Derivatives in Leprosy and Experimental Tuberculosis," by Dr. E. L. Walker, Dr. C. G. MacArthur and Dr. M. A. Sweeney, George Williams Hooper Foundation for Medical Research. Dr. Walker.

Dr. E. L. Walker, San Francisco: It might be well first to recapitulate briefly the reasons for undertaking this investigation. As you probably know, chaulmoogra oil has had an empirical reputation for the treatment of leprosy which extends back to prehistoric times. In recent years there have been very promising results obtained in the use of certain derivatives of chaulmoogra oil for the treatment of leprosy, especially by Sir Rodgers in India, using sodium salts, and by a group of men in the Hawaiian Islands using the ethyl esters of the chaulmoogric acids. In the Hawaiian Islands 150 or more cases of leprosy have been paroled as apparently cured during the last two years and a half. Powers and his collaborators, in the Wellcome Laboratories for Chemical Research

in London, from 1904 to 1907 made a very complete chemical study of chaulmoogra oil and they found that the oil consisted of glycerol esters, of a group of fatty acids which were peculiar in that they contained a closed carbon ring, which is found in no other known fatty acids.

In 1918 I became interested in investigating in the laboratory what was the active therapeutic principle in chaulmoogra oil, and I was able to demonstrate that the chaulmoogric acids had a remarkably high bactericidal activity which was specific for the acid-fast group of bacteria, this group of course including the tubercle bacillus, and consequently I suggested that chaulmoogra oil or its derivatives might have some therapeutic value in tuberculosis.

These, briefly, are the main reasons for undertaking this investigation. There is, however, another reason. There was danger, and it has been realized to some extent, that pharmaceutical houses and unscrupulous quacks would proceed with this half knowledge to exploit chaulmoogra oil for the treatment of tuberculosis on a large scale; and it seemed wise to have some definite scientific knowledge of whether or not the chaulmoograte had any value in the treatment of tuberculosis.

SECOND PROGRESS REPORT ON THE INVESTIGATION OF THE CHEMOTHERAPEUTICS OF CHAULMOOGRA OIL AND ITS DERIVATIVES IN LEPROSY AND EXPERIMENTAL TUBERCULOSIS*

By Ernest Linwood Walker, B.A.S., S.B., S.D.,
Charles G. MacArthur and Marion A. Sweeney

San Francisco

In a first progress report, communicated to the National Tuberculosis Association last year, three main lines of investigation on this problem were purposed, namely: (1) the preparation of derivatives of chaulmoogra oil for therapeutic experiments; (2) a biochemical study of the fate of chaulmoogra oil and its derivatives in the animal body; and (3) the therapeutic action of chaulmoogra derivatives on experimental tuberculosis. A summary of the progress of the investigation along these three lines is presented in this report.

I. THE PREPARATION OF DERIVATIVES OF CHAULMOOGRA OIL

Of the ordinary compounds of the chaulmoogric acids, the sodium and potassium salts are water soluble and the series of esters are light fluids; all other compounds have been found to be insoluble and of a fatty or waxy nature and are consequently unsuitable for therapeutic use. The sodium and potassium salts, being soaps, are very irritating to the tissues. Special attention has been devoted to the preparation of the esters, on account of their thin fluid consistency and neutral reaction and because of the superior therapeutic results claimed for the ethyl esters in the treatment of leprosy.

The essential steps in the preparation of these esters are the separation of the fatty acids from chaulmoogra oil by saponification with hot alcohol-potash solution, the esterification of the fatty acids by passing dry hydrochloric acid-gas to saturation through a heated solution of the chaulmoogric acids in the appropriate alcohol under a reflux condenser and the purification of the esters by distillation at high temperature under vacuum. The benzyl ester, being decomposed by the high temperature of distillation, was purified by filtering through bone charcoal.

* From the George Williams Hooper Foundation for Medical Research University of California Medical School, San Francisco.
Work done under grant of the Committee on Medical Research of the National Tuberculosis Association.

The different esters have been found to vary greatly in the reactions which they produce when injected into animals. Some of them, such as the methyl and the amyl esters, cause pain, oedema, hemorrhage and necrosis at the site of injection and systemic disturbance, as indicated by progressive loss of weight and condition of the animals, when given in repeated injections. These esters are wholly unsuitable for therapeutic use. The ethyl ester, now used so extensively in the treatment of leprosy, is open to the same objections of local and constitutional reactions, although to a lesser degree than the methyl and amyl esters. Tuberculous rabbits, treated with the ethyl ester in doses larger than 0.0715 cc. per kilo of body weight, develop so severe and persistent local reactions that treatment has to be discontinued. Leper patients under treatment with ethyl ester complain of pain and persistent soreness at the site of injection and some of them suffer so severe constitutional disturbance that continuation of the treatment becomes impossible. In contrast to these esters, two new esters, that we have prepared, the butyl and the propyl esters, produce practically no local reactions or systemic disturbance in experimental animals, even in double the standard therapeutic dose administered repeatedly over long periods of time. Trial of these new esters on a limited number of lepers has confirmed the absence of unpleasant reactions and has given as good therapeutic results as the ethyl ester. We believe these new esters to be superior for therapeutic purpose to any derivative of chaulmoogra oil hitherto produced.

Further work on the preparation of new derivatives has been discouraged by the results of our biochemical study of the fate of chaulmoogra derivatives in the animal body. We had hoped that some derivative could be produced which would be capable of circulating and penetrating the tubercular lesions unchanged; but our bio-chemical studies indicate that in whatever form or route the chaulmoogric acids are introduced into the body, the compound is hydrolized and the chaulmoogric acids are metabolized like ordinary fats. Therefore, the value of any new compound is reduced to the questions of its absorbability and freedom from toxic reactions. There remains, of course, the possibility of some chemical modification of the chaulmoogric acid molecule more profound than the substitution of the hydrogen atom in the carboxyl radical of the side chain, such as an elimination of a part or a whole of the side chain, or substitution in the ring, which might alter the physiological behavior without destroying its bactericidal property.

II. THE FATE OF CHAULMOOGRA OIL AND ITS DERIVATIVES IN THE ANIMAL BODY

In undertaking our biochemical study of chaulmoogra oil, we were confronted at the outset by the problem of methods of isolating and identifying minute quantities of the chaulmoogric acids in the presence of relatively large amounts of other fats in the animal body. There

exist no precise methods of separating the different fatty acids nor delicate chemical tests for the individual fatty acids. While the fatty acids of the chaulmoogric series differ fundamentally in chemical structure from other fatty acids, we have been unable so far to devise a satisfactory chemical method for their separation and estimation. Fortunately, however, the chaulmoogric acids possess a physical peculiarity, optical activity, associated with their ring structure, which is not a property of other fatty acids. Making use of this optical activity, we have devised a technic by which, after appropriate chemical treatment of the tissues or body fluids, we are able to read quantitatively the chaulmoogric acids with the polariscope, in the presence of other fatty acids in the solution, in amounts as small as one milligram. This test, while not so delicate as might be desired, has proved fairly satisfactory in this investigation.

The first step in the study of the fate of chaulmoogra oil and its derivatives in the animal body has been to determine their absorption by different routes. When ingested, the absorption of the chaulmoogric acids from the alimentary tract has been found to be as complete as is the absorption of other fats, namely, from 95 to 98 per cent. of the ingested fatty acids. From the completeness and rapidity of the absorption by this route, it would appear that the old method of treating leprosy by ingestion of the crude chaulmoogra oil should be as effective, except for the gastric disturbances, as the newer method of intramuscular injections. The gastric disturbances can be greatly minimized by the use of our new esters and by administration in enteric capsules.

Injected into the tissues, chaulmoogra oil and its derivatives are more rapidly absorbed from the muscle than from the subcutaneous tissues or the serous spaces. Moreover, when injected subcutaneously, between the muscles or into the serous spaces, there is an extensive coagulation of serous exudates forming large caseous masses that are very slowly absorbed. The relative rates of absorption from muscle and from subcutaneous tissue is shown in a typical experiment in which 0.2 cc. of the butyl ester was injected intramuscularly in two places and subcutaneously in one location on the same rabbit. Chemical analyses showed the following amounts in terms of chaulmoogric acids were absorbed from each locality.

TABLE I.

Comparison of Intramuscular and Subcutaneous Absorption

1.	Intramuscular	118	mgs. absorbed per day
2.	Intramuscular	108	" " " "
3.	Subcutaneous	66	" " " "

Since intramuscular injections of chaulmoogra oil and its derivatives have been practiced so extensively in the treatment of leprosy, absorption from the muscle tissue has been especially investigated. The primary purpose of the Heiser and other mixtures of chaulmoogra oil with lighter oils was to secure more rapid absorption of the heavy chaulmoogra oil,

which solidifies at 22°—23° C.; and one of the special recommendations of the ethyl esters has been that, being light fluids, they should be more rapidly absorbed than the oil or its mixtures. Chemical analyses do not wholly support these expectations. While our analyses do show some variation in the rates of absorption of the oil and its derivatives, the difference is not so great as expected. The relative rate of absorption of crude chaulmoogra oil and some of its derivatives, when injected intramuscularly in 0.2 cc. doses into the same rabbit, is shown in the following table.

TABLE 2

Comparison of Intramuscular Absorption of Chaulmoogra Oil and its Derivatives

SUBSTANCE	Chaulmoogric acids content, estimated in mgm.	Amount of chaulmoogric acids absorbed per day in mgm.
Chaulmoogra oil	180	85
Heiser's mixture[1]	180	85
Methyl ester	172	90
Butyl ester	144	95
Ethyl ester	162	100
Propyl ester	154	100
Amyl ester	136	100

[1] 0.4 c.c. injected because this mixture is half inert oil.

From the results of these analyses, it is apparent that the advantages which any of these derivatives may possess over crude chaulmoogra oil for therapeutic purposes is not great from the point of view of absorption; the advantage that some of the derivatives do possess is that they are less irritating and produce less local reaction in the tissues.

The rate of absorption varies with the amount injected and is roughly proportional to the size of the dose, within the limits of 0.1 to 0.4 cc. tested, as is shown in the following experiment with the butyl ester injected intramuscularly in different doses into the same rabbit.

TABLE 3

Relation of Size of Dose to Intramuscular Absorption

DOSE IN TENTHS C C.	Estimated chaulmoogric acid content of dose in mgm.	Mgm. of chaulmoogric acids absorbed per day
0.1	72	44
0.2	144	84
0.3	216	116
0.4	288	168

The rate of absorption from the muscles of the rabbit also appears to

be influenced by the size of the animal, as is shown by the following absorption tests of the butyl ester injected in the same dose into rabbits of different weights.

TABLE 4

Relation of Weight of Animal to Intramuscular Absorption

RABBIT NO.	Weight in grams	Dose of butyl chaulmoogrates in C C.	Estimated chaulmoogric acid contents of dose in mgm.	Mgm. of chaulmoogric acids absorbed per day
1	1760	0.2	144	58
2	3480	0.2	144	84
3	3820	0.2	144	120

Injected directly into the circulation, chaulmoogra oil derivatives are removed very rapidly from the blood. An animal dying immediately from a lethal intravenous dose may show a small amount of chaulmoogric acids in the blood; but an animal killed 15 minutes after a sublethal dose shows no trace of them. This method of administration undoubtedly secures the most rapid absorption of the drug, but the chaulmoograte are relatively toxic by this route and only small doses can be given.

Our investigation, so far as it has gone, indicates that the fate of the absorbed chaulmoogric acids, in whatever compound or way they may be introduced into the animal body, is the same; that is, they behave like other fats taken into the body and their fate is simply a question of fat metabolism.

In ordinary therapeutic doses chaulmoogra oil or its derivatives appear to be rapidly oxidized in the body metabolism. The evidence of this is of two kinds: First, it has not been possible to detect chaulmoogric acids in any fluids or tissue of the rabbit, even after long continued administration of therapeutic doses; second, in order to determine this oxidization more exactly, mice have been injected intraperitoneally with relatively large doses of chaulmoogra oil and of the various derivatives, and after a few days the whole mouse has been analysed for chaulmoogric acids. These experiments have shown that a considerable proportion of the chaulmoogric acids injected have been oxidized, at least to the extent that they are no longer optically active, in the bodies of the mice. The results of one such experiment are shown in table 5.

If, however, very large doses of chaulmoogra oil or its derivatives be administered at frequent intervals until a large amount has been given, chaulmoogric acids may be found in the blood, liver and fat. Thus 2 cc. of the butyl esters were injected intraperitoneally daily into a rabbit weighing two kilos, until 40 cc. had been given. On analysis of the blood and organs, 1,000 mgm. of chaulmoogric acids were found in the liver, but none elsewhere. To another rabbit, 4 cc. of the chaulmoogric acids were given daily by stomach tube until 40 cc. had been administered.

TABLE 5

The Rate of Oxidation of Chaulmoogra Oil and its Derivatives in the Mouse

SUBSTANCE	Amount injected in C C.	Chaulmoogric acid content estimated in mgm.	Mgm. of chaulmoogric acids recovered after 48 hours	Mgm. of chaulmoogric acids oxidized in 48 hours	Percentage of chaulmoogric acids oxidized in 48 hours
Chaulmoogra oil.....	0.1	90	54	36	40
Butyl esters.....	0.1	72	32	40	55
Methyl esters.....	0.1	86	30	56	65
Ethyl esters.....	0.1	81	24	57	79
Propyl esters.....	0.1	77	12	65	84
Amyl esters	0.1	68	4	64	94
Benzyl esters.....	0.1	68	0	68	100

Analyses showed 50 mgm. in the blood, 140 mgm. in the liver and 280 mgm. in the stored fat.

Fractionation by appropriate chemical methods of the chaulmoogrates found in the blood and tissues of animals treated with large doses, into fatty acid, fat and phospholipoid fractions, has demonstrated that the chaulmoogric acids may be present sometimes free, sometimes combined with glycerol as fat, sometimes in both forms and, apparently, at times in part as the phospholipoid, lecethin.

From the results of somewhat extended experiments along the above lines, we can construct a tentative scheme of the fate of chaulmoogra oil and its derivatives in the animal body. In ordinary therapeutic doses the chaulmoogric acids or their compounds are, after absorption, distributed by the blood to all of the tissues, which take them up as their physiologic needs for lipoids demand and rapidly oxidize them in their metabolism. There is no accumulation or storage in any tissue or organ, even after long continued treatment. On the other hand, if very large doses be administered at frequent intervals over a considerable period of time, there results, as in the case of an excess intake of any fats, a chaulmoogric lipaemia; the chaulmoogric acids are taken up by the organ chiefly concerned in fat metabolism, the liver, and the excess is stored in the adipose tissue as fat. In whatever compound and by whatever route the chaulmoogric acids are administered, they are probably hydrolized to the free fatty acids and then recombined to a greater or less extent with glycerol to form fat. If our findings of a small amount of chaulmoogric acids in the lecethin fraction be substantiated by further investigation, then it would appear that the chaulmoogric acids are able to take the place of other fatty acids in the synthesis of lecethin and possibly other phospholipoids.

The final step in our biochemical investigations, and one of particular importance from the point of view of the therapy of tuberculosis, is that of the penetration of the tubercle by the chaulmoogrates. So far as this part of the investigation has proceeded, the results have been completely

negative; the chaulmoogric acids do not appear to be capable of penetrating the tubercle in quantities that can be recognized by our tests. This conclusion is based not only upon analyses of lung and joint tubercles after extended therapeutic treatment, but also after repeated large local injections about living joint tubercles and after immersion of joint and lung tubercles, removed at necropsy, in solutions of sodium chaulmoograte for days at incubator temperature. These negative results conform with the observations of Wells[1] and his collaborators in their experimental study of the penetration of various substances into the tubercle, namely, that, while the tubercle is readily permeable to crystalloids, it is scarcely, if at all, permeable to colloids.

III. THE THERAPEUTIC ACTION OF CHAULMOOGRA DERIVATIVES IN LEPROSY AND EXPERIMENTAL TUBERCULOSIS

Chaulmoogra oil and its derivatives are definitely toxic; but, except for certain esters of which the toxic action is due largely to the alkyl rather than to chaulmoogric acid radical and unless introduced directly into the circulation, this toxicity is not great. Administered by mouth, the primary effect is nausea. To rabbits, which appear to be incapable of vomiting, 5 cc. of chaulmoogric acids or of the esters can be given by stomach tube, or the same amount of the esters by intraperitoneal injection without apparent ill effect; but, if this relatively enormous dose be repeated daily, there is progressive loss of weight and finally death of the experimental animal. However, a total of 40 to 50 cc. in daily 5 cc. doses has been given to rabbits weighing 2.5 to 3 kilos. In one case, 10 cc. of the butyl ester was given by stomach tube to a 2.6 kilo rabbit on three successive days, when the animal was found to be so ill that it was sacrificed for chemical examination.

Injected directly into the circulating blood chaulmoogra derivatives are much more toxic. This is probably due in part to the rapid absorption of the drug, but also in case of the esters and their emulsions to the mechanical action of pulmonary emboli. These emboli are produced not only by the oily droplets of the esters, but also by a coagulation precipitate in the blood plasma, similar in nature to that produced in serous exudates after subcutaneous and intraperitoneal injections. Twelve cc. of a 3 per cent. solution of sodium chaulmoograte injected intravenously into a 4 kilo rabbit in a period of 12 minutes was immediately fatal; but 10 cc. of the same solution injected intravenously into a 3.8 kilo rabbit in a period of 15 minutes produced no apparent ill effect on the experimental animal. One cc. of the propyl ester injected intravenously into a 2.5 kilo rabbit was immediately fatal; but a single dose of 0.5 cc. is tolerated. If, however, the smaller dose be repeated daily, the animal succumbs after several days to the cumulative action. These experimental data on the relatively high toxicity of the esters and their emulsions injected intra-

venously are of importance because this method of treatment is now being practiced in leprosy. It is evident that great caution should be exercised in the dosage and the interval between doses. Rabbits treated intravenously with therapeutic doses of the esters or their emulsions show marked hypertrophy of the lungs.

The standard adopted for calculating the dosage for treatment of experimental animals has been an equivalent per body weight of the maximum dose commonly used in the treatment of lepers, namely, 5 cc. of a 3 per cent. solution of the sodium salts intravenously and 5 cc. of the esters intramuscularly. This dosage, calculated on the basis of a 70 kilo man, is equivalent to 0.0715 cc. per kilo of body weight. This standard dose has been modified to suit experimental conditions, using fractions or multiples of it up to the largest tolerated dose. In case of the ethyl esters, the standard dose of 0.0715 cc. per kilo of body weight has been found to be the largest dose that can be used continuously, because of severe local reactions from larger doses. The butyl and propyl esters can be administered in much larger doses without severe reactions. We have been especially interested in intravenous injections of emulsions of the esters, since chemical analyses have shown that by this method of administration of tolerated doses it is possible to maintain constantly in the lungs a concentration of the chaulmoogric acids far above that proved to be bactericidal for tubercle bacilli in the test tube. While this concentration of the chaulmoogrates is probably largely in the capillaries in the form of emboli, it should afford most favorable conditions for absorption by the pulmonary tissues and penetration of pulmonary tubercular lesions.

With the cooperation of Doctors Morrow and Miller of the Dermatological Department of the University of California Medical School, we have had the opportunity to study the therapeutic action of the esters of chaulmoogric acids on a limited number of lepers at the San Francisco Isolation Hospital. This personal experience in the treatment of leprosy has been of great value in establishing a standard of therapeutic action of the chaulmoogrates, with which to compare the results in experimental tuberculosis. From our limited experience with leprosy, we are of the opinion that the therapeutic action of the esters of chaulmoogric acids is feeble. Early cases do improve under this treatment; but more advanced cases have shown little or no clinical or bacteriological change in their condition after more than a year of treatment. Chaulmoogra oil and its derivatives are the only drugs that have any definite therapeutic action in leprosy and their use in this disease is therefore amply justified; but the chaulmoogrates are nevertheless far from being ideal therapeutic agents.

Our therapeutic experiments on tuberculosis in rabbits have been in progress nearly a year and are not yet completed. Several hundred rabbits have been employed in these experiments; and these animals have been treated with the different derivatives that we have prepared in varying dosage and by different methods of administration. The thera-

peutic results, if any, are not striking enough to permit definite conclusions being drawn until all of these experiments have been terminated and the results carefully checked up. While deferring final judgment until all of the data are in hand, the general impression from the uncompleted experiments is that the therapeutic action of the derivatives of chaulmoogra oil on experimental tuberculosis is slight, if any.

This impression is supported by the results of our biochemical investigations and by experiments being conducted to determine the bactericidal activity of the chaulmoogrates *in vivo*. Our biochemical studies have shown that it is not possible to obtain an appreciable concentration of the chaulmoogric acids in the circulation by the administration of therapeutic doses, and that it has not been possible to secure their penetration into the tubercle. In an attempt to study the bactericidal action of the chaulmoogrates *in vivo,* guinea pigs have been inoculated from the tubercular lesions of rabbits of our therapeutic series that had been treated with the various derivatives, administered by different routes, in different dosage, for variable lengths of time. In no case have the guinea pigs failed to become infected. Pursuing this line of experimentation further, injections of sodium chaulmoogrates or esters have been made directly into circumscribed caseous joint tubercles of living rabbits, in doses five to ten times the bactericidal concentration *in vitro*. After variable lengths of time, the contents of these injected tubercles have been removed and inoculated into guinea pigs. In every case, the guinea pigs have developed tuberculosis. These experiments demonstrate that the bactericidal activity of the chaulmoogrates on tubercle bacilli *in vivo* is decidedly less than *in vitro*. Whether this is due to a failure of the drug to diffuse into all parts of the tubercle, or to a fixation or oxidation of the chaulmoogric acids by the tubercle is undetermined. In any event, the failure of the chaulmoogrates to penetrate the tubercle and their enfeebled bactericidal activity *in vivo* indicates that the most we can expect therapeutically is some inhibition of the tuberculous process and not a radical cure. The complete data of this investigation, including that of the incompleted therapeutic experiments, will be published later.

In conclusion, I should like to express to the Research Committee and to the National Tuberculosis Association the appreciation that I have for their interest and financial assistance in this work, and above all I should like to express my approval of the policy of the Association to support research along lines relating to tuberculosis. As Dr. Lewis has so well said, all progress in the control of tuberculosis must depend upon accurate knowledge of the disease in all its relations, and such accurate knowledge can only be obtained through carefully conducted research.

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DISCUSSION ON PAPER BY DR. WALKER

Dr. Lydia M. Dewitt, Chicago: I might add just one word on my own experience. I have been, during the last year, using in connection with my mercury work, an organic mercury derivative of chaulmoogric acid, and while I find it has a high inhibitory value in the test-tube, it has not proven of any great therapeutic value.

Dr. S. C. Brooks, Washington, D. C.: May I ask Dr. Walker whether there is any possibility that the chaulmoogra radical instead of being oxidized when it is absorbed in the blood is hydrogenated or reduced, so that it appears in some of the other fatty acids?

Dr. Walker: There is no evidence that reduction might not occur. We simply assumed that it might be an oxidation. In any event, it is changed so that it is no longer optically active. That aspect of the question has not been followed up.

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FINDING AND CARING FOR THE TUBERCULOUS EMPLOYE*

By James A. Britton, B.S., M.D.

Chicago

About fifteen years ago an agitation was begun to control the spread of tuberculosis among employes of industrial establishments. It was said on so-called good authority that pulmonary tuberculosis was largely due to occupation, and that while the number of cases was not known in any industry, it was felt that the number was large and steadily increasing. From this agitation many special investigations were started by social organizations, labor unions, insurance companies, and by the management of large industries.

Previous to this time, except for employment in certain branches of railroad service and such municipal departments as that of fire and police, a routine physical examination of applicants for employment in civil occupations was unknown.

The special investigations undertaken showed that there were to be found among those working in almost every industrial group cases of open active pulmonary tuberculosis. The finding of those cases of tuberculosis gave rise to the same two questions that always occur in relation to the discovery of a case of any infections or contagious disease —1—What shall be done with those already infected, and 2—What shall be done to prevent others becoming infected?

The next few years saw the establishment all over the country of sanatoria built or subsidized by private organizations, labor organizations, insurance societies, and industrial groups. During the same period, in order to prevent the admission of new cases of active tuberculosis to industrial groups, the practice of making physical examinations of all applicants for employment was recommended and established in a great many places. With the establishment of a physical examination for all new employes, one of the constant sources of new cases of tuberculosis was largely eliminated; the problem however of discovering the cases of tuberculosis which developed among those already employed was not so easy or not so simple. To one who has not had experience in dealing with the various problems which arise between employer and employe, it might seem that this difficulty could be easily handled by simply arranging for periodic physical examinations of all those employed. There has been so much publicity and argument on the subject of periodic physical examina-

* Read by title.

tions for every one that there is no necessity for discussing the advantages of this plan here. It is conceivable that in certain communities or in certain groups a plan of periodic physical examination for everyone could be worked out so as to be mutually beneficial and satisfactory. But under existing conditions, I firmly believe that such a plan cannot be established except in a partial and incomplete way.

For example, it is a simple matter for one of the large industrial concerns to say to its employes, "We will provide a physical examination for every employe and if anyone is found who has tuberculosis we will provide sufficient funds to guarantee adequate sanatorium care until such time as he is able to resume his work and will guarantee him employment when this time comes." A large industry employing five, ten, or fifty thousand employes could make this sort of proposition without piling up an item of expense which would be more than a very small percentage of its payroll. We must remember, however, that for every large industry having five thousand or more employes, there are really hundreds of small establishments having less than one hundred employes and such an establishment would find the expense incident to the care of a single case of tuberculosis a very large percentage of its payroll; in fact so large as to make consideration of such a plan prohibitive.

Any method of supervising those already employed which means throwing out on the community those who are unable to work will never solve the problem. On the other hand, any plan of supervising the health of any group of employes must carry with it some plan of adequate care of those found suffering from disease. It is granted that it is possible to adopt and carry out almost any health conservation plan in any industry providing the industry is large enough. The same thing is not true of the individual small industry, but it would be true if instead of the individual small industry attempting to operate a health plan of its own, there were a sufficient number of small industries which were willing to pool their health interests.

While there are a number of large concerns in which health conservation plans have been established which provide for periodic inspections, or examinations of employes, and study and correction of all unhealthful conditions or places, in the great majority of industries this work falls far short of the ideal, and is generally incomplete and unsatisfactory.

While ten years ago the sum of our knowledge, as voiced by one of the most prominent health students in this country, indicated that tuberculosis was largely of industrial origin, the present knowledge of this subject shows that there are comparatively few occupations where the job itself is responsible for more cases of tuberculosis than the average in the community. Ten years ago the average industrial establishment showed approximately the same tuberculosis rate as that in the community. At the present time in an industry where it is the practice to examine all new employes and conduct more or less regular inspections or examinations of those employed, the rate varies from one-fifth to one-half of the rate in the general community.

In any large industry certain jobs are found to have a rate considerably higher than that for the entire industry. Fortunately these jobs are few. Likewise certain industries are found to have higher rates than the average.

A few years ago those of us who were in tuberculosis work heard a great deal about the prevalence of tuberculosis among printers, cigar makers, and employes in the clothing trades. At that time it was thought that there was something inherent in the work itself which was responsible for the disease. We heard a great deal about posture and various kinds of dust. We now know that there is nothing inherent in any of these jobs which makes the job itself a health hazard. When we compare the modern print shop, cigar factory, or tailor shop with the working places in these same industries of fifteen years ago, we know that the important factors in the production of tuberculosis in those industries were not inherent in the job itself but the place and manner in which the work was done. When we compare the living conditions of the average worker in these trades fifteen years ago with present living conditions in these same trades and see the improvement which has resulted from better wages and hours, we know again that home surroundings have a great deal more to do with the health in these industries than posture or dust.

Unfortunately, there are occupations where cases of tuberculosis can be definitely tied up to the job as a casual factor. This is particularly true in certain types of grinding. Grinding which uses the old fashioned large wet grindstone produces a fine, sharp, cutting dust which causes gradual and permanent changes in the lungs, making a condition particularly favorable to the development of lung infection. Incidently the prognosis for the arrest of the disease which has developed in this type of case is very poor.

One of the complicated industrial causes of tuberculosis was associated with drinking; a few years ago it was customary to permit employes of steel mills, foundries, forge shops, and employes of other hot or dusty jobs not only to drink as much liquor as they wished outside of the job, but to carry liquor into the workshop. The combination of a hot job and too much liquor resulted in disturbances in digestion which undermined resistance and made conditions right for the development of tuberculosis. I think it is the common experience of those who deal daily with those who are employed in industries that the lack of opportunity for the average workman to treat every cold with Rock and Rye has made it possible for us some day to convince the average comsumptive that milk is the only kind of medicine that comes out of a bottle that will do him any good.

The care of the tuberculous employe is no different from the care of any other tuberculous member of the community. While it is possible to get as good results by treating a patient in his own home as it is in some sanatorium, it has been my experience that an arrest of the disease sufficient to warrant returning to work can be obtained in much

less time and in a much higher percentage of cases if the patients have a few months sanatorium care than if they are treated at home. In my opinion, then, it is of the utmost importance if any industry wishes to do aggressive, effective work in the rehabilitation of its tuberculous employes to provide for sanatorium care.

While I believe that tuberculosis like any other communicable disease is in a large measure a community problem and that care of cases of tuberculosis should be provided for in public institutions at the expense of the general community, the handicaps under which even the best public sanatoria labor at the present time make it rather difficult to persuade the average employe of an industrial concern to accept care at one of these public institutions unless he is very ill. Because the average well run private sanatorium does not have to contend with the same handicaps as most public institutions, the service to the individual patient is usually more satisfactory and the period of treatment much shorter.

The so-called industrial tuberculosis work was begun in some instances as a special piece of health work. The original propaganda leading up to this work emphasized all through the importance of special plans for discovery of cases, special personnel, and special provision for treatment of cases. It is impossible in industrial work, in justice to every one concerned, to pick out one special phase of medical work and emphasize it without consideration of other diseases and other medical problems. While, for example, heart disease has not had anything like the special consideration by industrial physicians that has been given to tuberculosis there is every reason to believe at the present time that heart disease among industrial employes from the standpoint of number of cases and economic loss is even a greater problem than that of tuberculosis. In my opinion the plan for the discovery of cases of pulmonary tuberculosis among employes should be only a part of some comprehensive health supervision scheme. As stated before, at the present time we do not need to argue the benefits of periodic physical examinations. The advantages of these examinations have been shown repeatedly. The only thing that stands in the way of developing a routine periodic thorough physical examination is the necessity for some comprehensive plan for taking care of those physical handicaps discovered when such examinations are made.

Shop conditions, and by this is meant both the sanitary conditions of the working place and the hazards of the job, are in most industries being rapidly and systematically checked and unsatisfactory conditions are being eliminated or corrected. This is the usual thing found in the modern progressive industry.

The modern industrial physician's office not only keeps track of every single accidental injury and how, when, and where it occurred, but the same system of records is maintained for every case of illness developing among the employes. Such records, in exactly the same manner as

they point to defective machines or the lack of safety appliances, point out the unsanitary work room and the dangerous job.

In order to do a satisfactory job in finding and caring for the tuberculous employe, it is necessary to have a plan, an equipment, and a personnel which can not only give satisfactory service to the case of tuberculosis, but can also give this same service to an employe regardless of whether he has this disease, or disease of kidney, heart, or nervous system, or anything else which does or might interfere with or stop his work.

There are a great many problems which have come up in the so-called field of industrial medicine which have caused considerable divergence of opinion regarding the limits of this field. There can be no difference of opinion, however, regarding some of the basic essentials. Both for the sake of the employe and the industry in which he is employed, it is necessary that his tuberculosis as well as his other diseases be discovered when there is some chance of arrest or cure. In order to do this it is essential that the medical personnel in an industrial establishment be made up of well trained physicians, surgeons, technicians, and nurses. The day is past when the "first aid boy" will serve the purpose. In addition, the industrial physician's office must be equipped for thorough and accurate work.

The industrial physician who serves the community best will not in my opinion ever have much to do with the treatment of individual cases. He must be trained and equipped to recognize conditions and causes and to do this fairly accurately. Recognition of tuberculosis must be a part of his job, not all of it. While he will not treat many cases, he must know what is good treatment and where it can be had and the procedure necessary to get it.

To summarize:

1. The finding of cases of tuberculosis in an industrial establishment should be part of a comprehensive plan for health supervision.

2. Cases of active pulmonary tuberculosis like cases of other diseases must have good treatment. In tuberculosis this means sanatorium care.

3. Any comprehensive health supervision plan must include a satisfactory plan for treatment—simply finding and excluding those having disease from employment will not solve the problem.

The Chairman: Mr. Deacon, the Director of the New York City Tuberculosis Association, is to read the paper that was scheduled to be presented by Mr. Drolet, the Statistician of that Association.

J. Byron Deacon, New York: Mr. Drolet lavished thought and attention upon the preparation of this paper, and it was a bitter regret to him that a sudden onslaught of a quite severe illness prevented his attendance here and deprived him of the privilege of presenting this paper in person.

Just as Mr. Kingsbury made the very notable announcement of an experiment in the more intensified care of the tuberculous, so in some

sense this is a very modest announcement of an experiment quietly begun very recently in one clinic district of New York City, which looks to the application of the tuberculosis clinic to a field which appears to have been very extensively uncovered so far, namely: the discovery of tuberculosis among industrial workers.

EXTENSION OF TUBERCULOSIS DISPENSARY WORK INTO INDUSTRY

By Godias J. Drolet

New York

According to the figures of the National Tuberculosis Association, on January 1st of this year there were throughout the country some 558 tuberculosis clinics which hold regular sessions. In New York City since 1909 alone—for which period figures are available—the score of dispensaries in this city have examined 272,233 new patients, both tuberculous and non-tuberculous. To these the visiting nurses of the dispensaries in their follow-up work paid, up to the end of 1921, 1,028,171 home calls.

Dispensary control of tuberculosis has been so effective in the discovery, care and prevention of the disease, as well as economical when compared with the hospital and sanatorium institutional method, that it is suprising to find how little its organization and forces have been directed towards industry. In home work, it has become indispensable; but its visiting and direct educational influence have been practically confined to women and children. Wage earners and workshops are rarely included in the rounds of the dispensary visiting nurse.

In New York, thirty clinics, members of the Association of Tuberculosis Clinics of Greater New York, cover the entire five boroughs. During 1921 alone, the visiting nurses of the tuberculosis clinics paid 70,417 calls to the homes of patients and of contact members of the families under their care; in addition, the Department of Health nurses made 88,451 extra home visits for the sanitary supervision of the remaining tuberculosis cases "at home," not under clinic care. In all this tremendous volume of visiting, not one shop or working place was included. New York, in this absolute home direction of its tuberculosis forces, simply follows or sets the example of most organized anti-tuberculosis work, which, thus far, has been all directed towards family care and supervision.

And yet tuberculosis is primarily a man's disease, and above all a worker's disease. It should be unnecessary to stress this point, but I think it is still of importance to recall the facts as to the difference in the distribution of tuberculosis between the two sexes, and to hold clearly before our minds our main objective and responsibility. In New York—and the sex grouping of the figures repeats itself elsewhere—from 1910 to 1921, inclusive, we have had to register 112,318 deaths from

tuberculosis in its various forms (See table 1). Of these, 71,271 or 63 per cent. occurred in the male sex—that is, the deaths among them were almost twice as many as those occurring in the female sex. Furthermore, at certain ages, the preponderance among men is still greater. After 45 years of age, when most women are practically eliminated from business and few of them leave the home to enter commercial life, the death rate from tuberculosis in New York, during 1920, was 264 per 100,000 among men, and only 88 among women. In other words, it was three times as great among men as among women. Each year the New York tuberculosis mortality in the male sex has been well over 60 per cent. of all the deaths (see diagram 1), with only a slight recession during the war years, when, probably because of the greater incoming of women into industry and a sharing of the extra hazards outside of the home, there was a tendency to equalize the death rates.

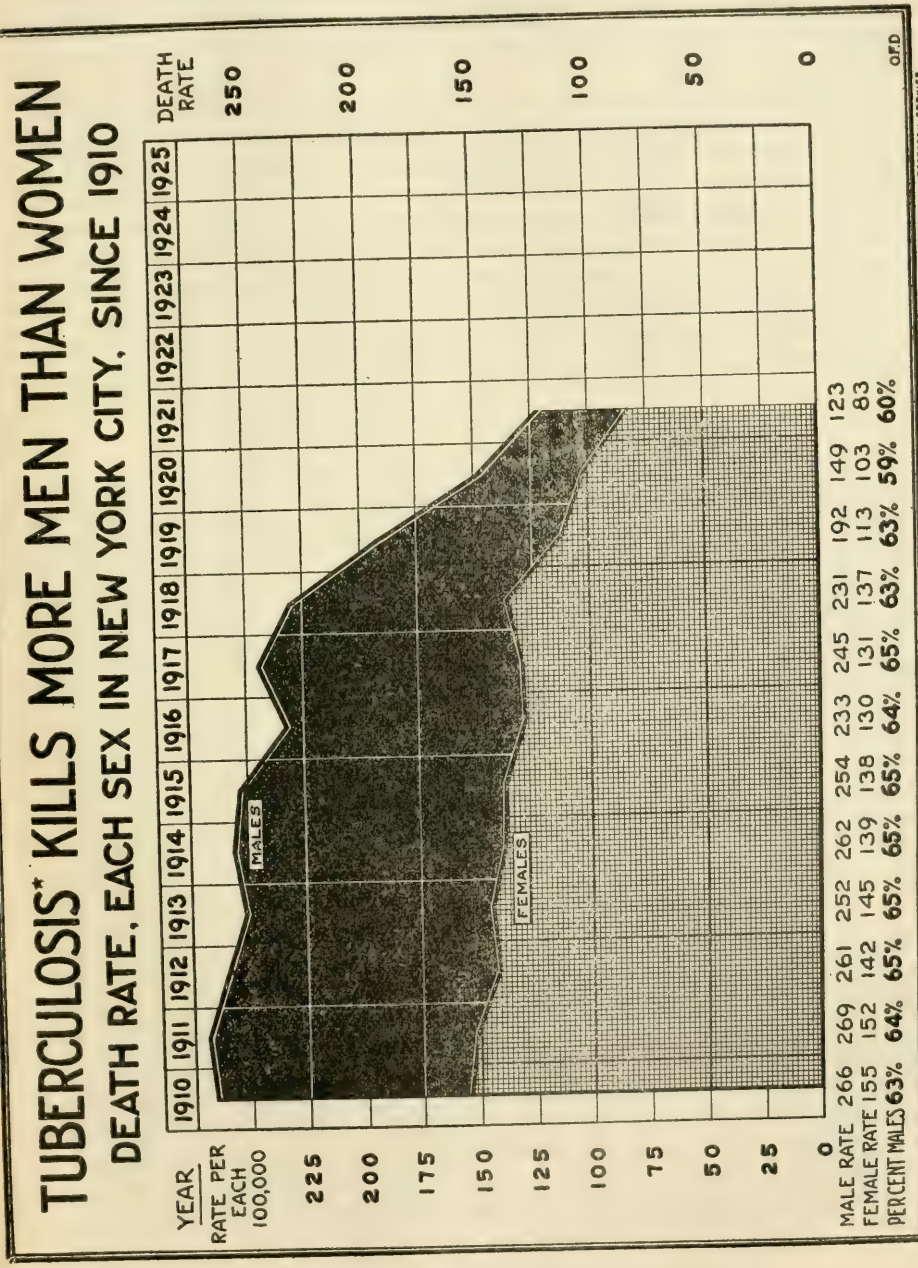
TABLE 1

New York City—Deaths From All Forms of Tuberculosis in Each Sex, 1910 *to* 1921

YEAR	Number of deaths				Death rate per 100,000	
	Males	Females	Total	Per cent. males	Males	Females
1910	6,352	3,772	10,074	63.1	266	155
1911	6,548	3,702	10,250	63.9	269	152
1912	6,465	3,516	9,981	64.8	261	142
1913	6,362	3,669	10,031	64.5	252	145
1914	6,716	3,574	10,290	65.3	262	139
1915	6,638	3,611	10,249	64.8	254	138
1916	6,185	3,463	9,648	64.1	233	130
1917	6,607	3,535	10,142	65.2	245	131
1918	6,318	3,780	10,098	62.6	231	137
1919	5,346	3,152	8,498	62.9	192	113
1920	4,211	2,924	7,135	59.1	149	103
1921	3,523	2,399	5,922	59.5	123	83

What is the explanation of this greater prevalence of tuberculosis among men? The general population is practically evenly divided between the two sexes. Home conditions and food supplies are fairly the same within families. Living quarters are shared at night. The main difference must be sought in the conditions outside the home and in the daily work. Men in much greater proportion than women are at work outside the home; physical, laborious work is more their lot. Overfatiguing work and unhygienic conditions, in the factory or in the trade followed, are the especial different dangers that men are compelled to incur. A complete tracing of tuberculosis to its source will not be attained until workshops are included in the daily round and are supervised precisely

as the home and children now are by tuberculosis or public health organizations.


TUBERCULOSIS* KILLS MORE MEN THAN WOMEN
DEATH RATE, EACH SEX IN NEW YORK CITY, SINCE 1910
YEAR
RATE PER EACH 100,000
DEATH RATE
MALES
FEMALES
1910 1911 1912 1913 1914 1915 1916 1917 1918 1919 1920 1921 1922 1923 1924 1925
MALE RATE 266 269 261 252 262 254 233 245 231 192 149 123
FEMALE RATE 155 152 142 145 139 138 130 131 137 113 103 83
PER CENT MALES 63% 64% 65% 65% 65% 65% 64% 65% 63% 63% 59% 60%
*ALL FORMS OF TUBERCULOSIS
G.J. DROLET, STATISTICIAN, RESEARCH SERVICE
NEW YORK TUBERCULOSIS ASSOCIATION
O.F.D.

MEN IN INDUSTRY

The 1920 Census on occupations[1] gives us quite accurate figures about men at work. It enumerates in New York City 1,839,683 men gainfully employed, as against 691,729 women—practically in the proportion of three to one.

The extent to which men in greater numbers than women are out at work has also been measured by a comprehensive census of workers in factories by the New York State Department of Labor.[2] In three of the large industries of New York—namely, men's tailoring, the making of women's clothes, supplies and apparel, and in the printing and bookmaking industry—some 152,510 employees were engaged. Outside of the office forces, which totalled about 14,000, these three large industrial groups employed 109,465 men as against 28,926 women—80 per cent. of the actual operators being men. Even in the making of women's clothes and supplies, 77 per cent. of the operators are men.

TUBERCULOSIS AMONG WOMEN

On the other hand, when women leave the home and enter industry, with its more steady wear of daily toil, tuberculosis mortality likewise rapidly rises among them. We all recall the experience in England, where vital statistics are so carefully recorded. The tuberculosis mortality among young women fifteen to twenty years of age was increased by 50 per cent. in 1917 over that of 1913.[3] In 1919 the increase had fallen to 30 per cent. The Metropolitan Life Insurance Company, whose policy holders are scattered throughout this country, and therefore are nationally representative, reported some time ago[4] that it was only young women between the ages of fifteen and nineteen who, in their experience, had not shared in the general tuberculosis decline. On the contrary, they found among these an actual increase of mortality. As war work has disappeared, the deaths in this group have again decreased. The importance of the industrial factor in tuberculosis among women was convincingly shown a few years ago, to any one who wishes to read the handwriting on the industrial wall, in the exhaustive report of the causes of death among women cotton mill operatives in Manchester, Pawtucket and Fall River, in the investigation conducted by Dr. Perry and reported upon in the United States Senate Document No. 645 of the 61st Congress. He found that "the death rate of female operatives from tuberculosis was in general more than twice that of non-operatives."[5] In these three cities, among women of the same age, the tuberculosis death rate was twice as high among those working in the mills as among those remaining at home. Among older women, between 35 and 44 years of age, who presumably had been longer at work in the mills, the tuberculosis death rate reached as high as five times that of the women of the same age group staying at home.

PROGRESS IN THE UNITED STATES

Broad evidence of the probable very great influence of industry in tuberculosis is contained in a recent United States Public Health Report.[6] The figures of mortality which it gives for the entire United States registration area, in 1920, as against 1910, show that the tuberculosis decline throughout the country amounted to 29 per cent. in the entire population during that decade. However, while in children under one year old the reduction has been the greatest, i.e. 46 per cent., followed by a decline of 37 per cent. among children from one to fourteen, in the adult group from fifteen to forty-four the reduction has been below the average, namely 22 per cent., or one-third less than the general tuberculosis reduction.

The evidence is conclusive. Tuberculosis work, addressed as it is primarily to the home and especially to the protection of childhood, has been steadily and progressively effective; but the wage earner and industry have been practically untouched.

NEED OF DISPENSARY IN INDUSTRY

Granted, therefore, that tuberculosis is most prevalent among adult wage earners, and that that field has been covered by organized anti-tuberculosis forces, what is the best practical method of including it in the general program of work? Shall it be through the development and addition of medical personnel within the industries themselves? These departments, where they exist, already acknowledge themselves overburdened with the care of ordinary emergencies and accidents, and are practically unable to undertake general medical examinations, aside from the fact that they are often under suspicion by the employees and unions as being mere protective devices for a more complete control by the employer. Or shall it be by the incoming of those best fitted by experience and often backed up by public resources, namely, the tuberculosis dispensary physicians and visiting nurses, with their close contact with public and private institutions for the proper disposal of cases of tuberculosis?

The industrial field is too vast, the tuberculosis problem still too difficult, to refuse the aid of any agency or of any one, but again let us look at the extent of our problem, its location and the nature of some of the difficulties to be encountered, if we wish to meet it adequately. The previously mentioned industrial survey in New York State discloses a fact that should always be remembered as to working places, namely, that the average business establishment is far from being a large one, or one with resources able to provide all the modern requirements for health. In New York City, among 1,197 factories in the garment making and printing industries, taken at random from the general list, only 14 establishments, or 1 per cent. of them, employed more than 500 employees each, while 1,054, or 88 per cent. had forces of less than 100 employees

each. In other words, the very great majority of working places are small, and are obviously unable to afford medical or welfare departments of their own. Their commercial stability is likely to be precarious, and their trades and business carried on under probably unfavorable conditions. These are the establishments where tuberculosis most commonly arises. For such concerns the organized public dispensary is perhaps the only competent tuberculosis medical service that could reasonably and quickly be made available.

GOUVERNEUR INDUSTRIAL HEALTH SERVICE

Realizing the omission of attention to the workers and their places of employment in their district, the Gouverneur Tuberculosis Clinic in New York City has recently undertaken the extension of its work into that part of the field. The Gouverneur Out-Patient Department is part of the New York City Department of Bellevue and Allied Hospitals and is located in lower Manhattan. It is in a section which, in common with other downtown parts of New York, has changed from a residential to a business quarter. This shift of population is duplicated in the heart of all our big cities. Home dwellers move away and only a day population of workers residing elsewhere takes their place. The Gouverneur clinic—which, in 1903, started the first municipal tuberculosis class in the United States—has an experienced staff of physicians and workers, well backed with social support by an active auxiliary. With the change in character of the neighborhood, and with a remaining population practically all Jewish with a low incidence of tuberculosis, Gouverneur found its ordinary home and clinic work fast diminishing; and yet at its very doors were a number of establishments with thousands of workers, among whom no special or direct tuberculosis work was done. At the suggestion of the New York Tuberculosis Association, which had been drawing attention to the anomaly and greater amount of tuberculosis among men, it decided to send out its physicians and nurses into the district and actually undertake an industrial health survey as well as the actual examination of workers wherever they could be induced to accept it. Early in this year a nurse was assigned to spend her full time in this work. A number of physicians, who previously had been doing only clinic duty within the dispensary, were released for work outside in the factories, to equal in time the number of hours ordinarily spent in the clinic.

A preliminary survey of neighborhood establishments was made. Friendly visits to managers readily secured permission to enter the shops and to place before the workers an offer of medical examination. Educational posters stressing the advantages of examinations were first distributed, and, usually at noon hours, talks were given personally by the clinic physicians offering the new service. Though the survey is conducted primarily for the discovery of tuberculosis, this point is not stressed and, as the examination given is fairly general, the presentation

FORM D

GOUVERNEUR HEALTH SURVEY—PLANT RECORD

Business Name L---N---Co. Nature of business or work: Manufacturing shirts

Address Water Street Date of Visit: February 15, 1922

Personnel Mgr. (Name): Mr. C--- Official interviewed (Name, Title): Mr. C---, manager

Hours of Business or Work: 8 a.m.–5.30 p.m. Operators do not work on Saturday

Number of Employees (Total): 275 Men: 100 Women: 175 Main racial groups: Hebrew, Irish, Italian, Polish

Medical Personnel, or Welfare Worker (Name) (Title): ——

Opportunities for addressing employees (Place) (Time): March 10, 1922—top floor of building Weight Scales: No

Room or place for examination (Place) (Time): second floor of building

Modern concrete, all windowed building; one block square

Impression of Plant: Making and laundring of shirts (Character of work) Conditions of work: good (Ventilation) good (Lighting) clean (Cleanliness, dust) good (Sanitary facilities)

Factory faces East River, excellent air and light, free from dust

Remarks: March 10, 1922: Dr. Narins and Dr. Goldstein visited plant. Dr. Narins gave health talk to employees on top floor of building. Mr. C---, the manager very co-operative.

April 18, 1922: Visited Mr. C--- for follow up health talk by Dr. Galdston, New York T. B.

Form B

L---N--- Co (Continued).

March 10, 1922: Dr. Narins gave a health talk to the employees on the top floor of the building — attendance the entire plant. Mr. C---, the manager was very co-operative. On pay roll 220 employees. At this date 113 examined.

April 18, 1922: Plant revisited for a follow up visit. Mr. C--- willing for another health talk, to be given to the employees on April 26, 1922 Talk to be given on employer's time. Employees will stop work at 20 minutes to 12 noon.

of the subject has been mainly from the point of view of maintenance of general health.

The plants visited so far are comparatively small establishments without medical departments and, as in all the general tuberculosis clinic work of New York City, the examinations are given free of charge. There is certainly—if only from the selfish point of view of the protection

of the community—sufficient reason for undertaking this work free of charge to find and remove cases of tuberculosis from places where they may be contaminating food supplies and other workers. Besides, it is only a discovery service and not a plan for treatment, though the latter is already provided for in the regular work of the thirty dispensaries

GOUVERNEUR HEALTH SURVEY -- MEDICAL RECORD

NAME B___ E___. Date March 28, 1922. Factory Employee No. 82.

Employed by L___ N___ Co. (Name of Firm or Employer) At Water Street (Address) Since 12 yrs.

Home Address Union Street, Bronx, N. Y. City

Occupation. General nature of industry or business: Particular Occupation: Previous Occupation:

Sex F Age 25 yrs Color W. Birthplace: Pt. Austria (Country) F. Austria M. Austria. Religion Hebrew. (How long)

Hours of Work: 48 hrs a week. (Total daily, outside of Lunch) Conditions of Work: good, in a modern concrete, all windowed bldg, no dust.

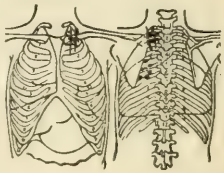
Previous History

Had "Flu" two years ago Frequent colds.

Remarks Lost weight since last summer — previous wt. 136 lbs., present wt. 125 lbs.

Present Condition Feels weak

Physical Examination T 99° P 88 Present Weight 125 lbs Height 5 ft - 1/2 in Standard Weight 120 lbs.



Lungs Impairment of resonance over left apex. Breathing harsh over same area. Sub crep. rales heard after cough over left apex anter. & poster.

Heart neg.

Other Organs neg

M. D.

Diagnosis Pulm. Tbc. suspect.

Recommendations Referred clinic for another examination.

Subsequent Action Reexamined April 1, 1922: Physical exam as above plus sub crep. rales during coughing at angle of scapula left post. as indicated. C. Blum M. D.

Diagnosis: Pulm. Tbc., first stage

Sister of patient called in, instruction given, separate room, dishes, etc.

Form A

which are members of the Association of Tuberculosis Clinics of Greater New York, and in the various other tuberculosis institutions in the city.

The employees are told that the findings will be kept strictly confidential—though of course this refers only to results being divulged to their employers or to other workers—but it does not mean any nullification of the sanitary code which requires that all tuberculosis cases wherever found in New York City must be registered with the health authorities. This protection of the findings, in the same way as would be given in private practice, is an essential keynote if unimpeded progress in this field is to be made.

Employees are naturally always suspicious of examinations conducted by the employers themselves. Even strikes have been known to occur where such general medical examinations were required without proper assurance of the privacy of the findings. It is explained to the workers that it is only a discovery health service—that if they are found to be ill they will be directed to their private physicians, or if unable to pay they will receive the advantages of every social service facility of the dispensary in securing proper treatment for the correction of defects.

The tuberculous employees found working in the Gouverneur district, but residing out of it, will, in the same way as in all clinic work in New York, be duly transferred and given the address of the clinic nearest their homes. The Gouverneur plan provides for examination of workers at whatever place possible. Before embarking upon this work, it had been supposed that it would probably be impossible to get any of the workers to come to the tuberculosis clinic itself. Contrary to this, however, it has been found that an almost equal number have come to the dispensary for their examinations. It may be that they feel more secure and private there.

Those examined at the factories have been usually those living out of the district who could not readily come after working hours. Some of them have been examined at the clinic during the day on a release by the employers. Every effort has been made to meet their convenience. When examining at the clinic, in the late afternoon between half-past five and seven o'clock, only a limited number with definite appointments have been allowed to come, so as to reduce their waiting. For others, obliged to go home quickly in the evening, examinations have been made at the factories between 11:45 A.M. and one o'clock.

In the case of workers on night shifts, a physician living in the district has even taken the trouble to go to the establishments and give talks and appointments as late as nine in the evening. The spirit that the Gouverneur staff has displayed in this pioneer work is bound to spell success and is also an expression of their conviction of the usefulness of this work.

General examinations of industrial workers compel one to admit that they are of necessity very laborious, and that one of the main difficulties is how to reach the tuberculosis cases quickly where medical staffs are

limited. There is need of some sifting method. The simplest sifting process, at least as respects tuberculosis, probably would be the preliminary weighing of employees by a social worker or by an assisting clerk

GOUVERNEUR HEALTH SURVEY

Miss E--- B---.

Employed by L--- N--- Co.

At Water Street.

IS REFERRED FOR PHYSICAL EXAMINATION TO
GOUVERNEUR HEALTH SURVEY CLINIC AT
GOUVERNEUR HOSPITAL OUT-PATIENT DEPARTMENT
GOUVERNEUR AND WATER STREETS

On Saturday day April 1, 1922 at ~~A.M.~~ 3 P.M.

A. E. C---.
(EMPLOYER)

Date March 29, 1922.

Mr. A--- St---.

Examined by Dr. Narins of the Gouverneur Health Survey is found to have post. influenzal bronchitis.

Recommendations: Place yourself under care of your physician.
~~IF UNABLE TO AFFORD TREATMENT PRESENT THIS~~

At X Clinic

Address X

FORM C

with comparison of the results against standard weight tables. It is probable that the majority of tuberculosis cases would be found within the group ten per cent. underweight. There is no reason why the nutri-

tion class method of selection so practically worked out for children should not be utilized for selecting those in need of immediate examination. Or the method worked out in Chicago, of referring for examination those frequently ill or suspected by foremen and others of illness, might be used. Or again a social worker going through the plant weighing

TABLE 2

*STANDARD WEIGHT TABLE**

for

MEN

"In Ordinary Street Costume, With Overcoats Removed"

(*Light-Faced Figures Indicate Ten Percent. Under The Average*)

HEIGHT		AGE PERIOD													HEIGHT
Ft.	In.	15	16	17	18	19	20 to 24	25 to 29	30 to 34	35 to 39	40 to 44	45 to 49	50 to 54	55 to 59	Ft. In.
5	—10%	96	98	100	102	103	107	112	114	116	119	121	121	122	
	0	107	109	111	113	11 5	119	124	127	129	132	134	135	136	5 0
	—10%	98	100	102	103	105	109	113	116	118	121	122	123	124	
	1	109	111	113	115	117	121	126	129	131	134	136	137	138	1
	—10%	101	103	104	106	108	112	115	118	120	122	124	125	126	
	2	112	114	116	118	120	124	128	131	133	136	138	139	140	2
	—10%	103	105	107	109	111	114	118	121	122	125	127	128	129	
	3	115	117	119	121	123	127	131	134	136	139	141	142	143	3
	—10%	106	108	110	112	113	118	121	123	126	128	130	130	131	
	4	118	120	122	124	126	131	134	137	140	142	144	145	146	4
	—10%	110	112	113	115	117	121	124	127	130	131	133	134	135	
	5	122	124	126	128	130	135	138	141	144	146	148	149	150	5
	—10%	113	115	117	119	121	125	128	130	133	135	137	138	139	
	6	126	128	130	132	134	139	142	145	148	150	152	153	154	6
	—10%	117	119	121	122	124	128	131	134	137	139	140	141	142	
	7	130	132	134	136	138	142	146	149	152	154	156	157	158	7
	—10%	121	122	124	126	128	131	135	141	141	143	145	146	147	
	8	134	136	138	140	142	146	150	154	157	159	161	162	163	8
	—10%	124	126	128	130	131	135	139	142	146	148	149	150	151	
	9	138	140	142	144	146	150	154	158	162	164	166	167	168	9
	—10%	128	130	131	133	135	139	142	147	150	152	154	155	156	
	10	142	144	146	148	150	154	158	163	167	169	171	172	173	10
	—10%	132	134	136	138	139	142	147	151	155	157	159	160	161	
	11	147	149	151	153	155	158	163	168	172	175	177	178	179	11
6	—10%	137	139	140	142	144	147	152	157	160	163	165	166	166	
	0	152	154	156	158	160	163	169	174	178	181	183	184	185	6 0
	—10%	141	143	145	147	148	151	157	162	164	168	171	172	173	
	1	157	159	161	163	165	168	175	180	184	187	190	191	192	1
	—10%	146	148	149	151	153	156	163	167	172	175	177	178	179	
	2	162	164	166	168	170	173	181	186	191	194	197	198	199	2
	—10%	150	152	154	156	157	160	168	173	177	181	184	184	185	
	3	167	169	171	173	175	178	187	192	197	201	204	205	206	3
	—10%	155	157	158	160	162	165	173	178	183	187	190	191	192	
	4	172	174	176	178	180	183	193	198	203	208	211	212	213	4
	—10%	159	161	163	165	166	169	177	183	188	193	195	196	197	
	5	177	179	181	183	185	188	197	203	209	214	217	218	219	5
Ft.	In.	15	16	17	18	19	20 to 24	25 to 29	30 to 34	35 to 39	40 to 44	45 to 49	50 to 54	55 to 59	Ft. In.
HEIGHT		AGE PERIOD													

*Adapted by G. J. Drolet from Report of the Medico-Actuarial Investigations, N. Y., 1912, of 221,918 men accepted by American and Canadian Life Insurance Companies.

the employees could also quickly ask each person a few questions concerning the more common symptoms of tuberculosis, such as cough, spitting blood, pleurisy, etc., and could refer for immediate examination those arousing suspicion. At present, at Gouverneur Clinic all who wish are examined; but, if the work proves too heavy, the annual re-examinations will be limited to those more obviously in need.

TABLE 3

*STANDARD WEIGHT TABLE**

for

WOMEN

"In Ordinary Street Costume, With Overcoats Removed"

(Light-Faced Figures Indicate Ten Percent. Under The Average)

HEIGHT		AGE PERIOD													HEIGHT
Ft.	In.	15	16	17	18	19	20to24	25to29	30to34	35to39	40to44	45to49	50to54	55to59	Ft. In.
4	—10%	91	92	93	94	94	96	99	102	104	108	111	112	113	
	8	101	102	103	104	105	107	110	113	116	120	123	125	126	4 8
	—10%	93	94	94	95	96	98	101	103	106	110	112	114	115	
	9	103	104	105	105	107	109	112	115	118	122	125	127	128	9
	—10%	94	95	96	97	98	100	103	105	108	112	114	116	117	
	10	105	106	107	108	109	111	114	117	120	124	127	129	130	10
	—10%	95	97	98	99	100	102	104	107	110	113	116	118	119	
	11	106	108	109	110	111	113	116	119	122	126	129	131	132	11
5	—10%	96	98	100	101	102	103	106	109	112	114	118	120	121	
	0	107	109	111	112	113	115	118	121	124	128	131	133	134	5 0
	—10%	98	100	102	103	103	105	108	111	114	117	120	121	123	
	1	109	111	113	114	115	117	120	123	126	130	133	135	137	1
	—10%	101	103	104	105	106	108	110	112	116	120	122	124	126	
	2	112	114	116	117	118	120	122	125	129	133	136	138	140	2
	—10%	103	105	107	108	109	111	112	115	119	122	125	127	129	
	3	115	117	119	120	121	123	125	128	132	136	139	141	143	3
	—10%	106	108	110	111	112	113	116	119	122	125	128	130	131	
	4	118	120	122	123	124	126	129	132	136	139	142	144	146	4
	—10%	110	112	113	113	114	116	119	122	126	129	131	133	135	
	5	122	124	125	126	127	129	132	136	140	143	146	148	150	5
	—10%	113	115	116	117	118	120	122	126	130	132	136	137	138	
	6	126	128	129	130	131	133	136	140	144	147	151	152	153	6
	—10%	117	119	120	121	121	123	126	130	133	136	139	141	142	
	7	130	132	133	134	135	137	140	144	148	151	155	157	158	7
	—10%	121	122	123	124	125	127	130	133	137	139	143	144	147	
	8	134	136	137	138	139	141	144	148	152	155	159	162	163	8
	—10%	124	125	126	127	128	130	133	137	140	143	147	149	150	
	9	138	139	140	141	142	145	148	152	156	159	163	166	167	9
	—10%	128	129	130	130	131	134	137	139	143	146	149	153	156	
	10	142	143	144	145	146	149	152	155	159	162	166	170	173	10
	—10%	132	133	134	135	136	138	139	142	146	149	153	157	159	
	11	147	148	149	150	151	153	155	158	162	166	170	174	177	11
	—10%	137	138	139	139	139	141	143	146	148	152	156	159	164	
6	0	152	153	154	155	155	157	159	162	165	169	173	177	182	6 0
Ft.	In.	15	16	17	18	19	20to24	25to 2	30to34	35to39	40to44	45to49	50to54	55to59	Ft. In.
HEIGHT		AGE PERIOD													

* Adapted by G. J. Drolet from Report of the Medico-Actuarial Investigations, N. Y., 1912, of 136,504 women accepted by American and Canadian Life Insurance Companies.

The records used in the Gouverneur Industrial Health Survey have been kept fairly simple, though covering the essentials. In the whole plan, the enormous extent of the undertaking has been kept in mind and only the most simple and practical methods are first used. A physical examination taking about fifteen minutes is made. It covers a simple examination of the nasal and buccal cavities, the bared chest for lung and heart conditions, and the taking of blood pressure, with examinations of urine and sputum when indicated. The height and weight of all examined are taken. The records include, first, the plant card whereon are summarized the address and nature of the business engaged in, the names of officers interviewed, the number of employees and the opportunities for addressing or examining employees, as well as general impressions of the character and conditions of work. The medical history card is kept carefully under envelope and has the usual identification notes, with a careful differentiation of the particular occupation followed, the racial ancestry, the hours and conditions of work for each employee, with the usual previous history and present condition of health. The chest examination is noted in full and the usual graphic lung outline is at hand for the entry of findings. Recommendations are also duly noted on the record. There are, in addition, special cards given for appointments for examinations at the clinic, and for referring patients for treatment to their physicians or proper institutions when they are found to be suffering from conditions requiring attention.

Examinations so far have been conducted among workers from only three establishments: one, a candy shop; the second, a bakery; the third, a shirt factory. Thirty-four per cent. of the workers employed at the shirt factory were under twenty-one years of age—mostly young girls. It is in this group that perhaps the very significant and valuable suggestion of Dr. Emerson of Boston might be followed, namely that, among industrial workers who have not yet attained their full growth, health nutrition classes should be conducted similar to those among children who are underweight.

Fifty-two per cent. of all those examined were between twenty-one and fourty-four years of age. As already explained, the district is mostly Jewish, and seventy-five per cent. of the workers were of the Hebrew race. Eleven per cent. of those examined were found to be ten per cent. underweight. In the first hundred workers examined, two were found tuberculous, one an incipient pulmonary case and the other a surgical case. Twice as many cases were found suffering with serious cardiac conditions. The usual common physical defects made up the remainder of the list of impairments.

The greatest and most common defects were decayed teeth and diseased tonsils. These two groups of defects are generally held to be minor; but constantly affecting, as they do, the proper utilization of food and the capacity for breathing, there should be far greater facilities for giving them the attention they deserve. They are certain ultimately to affect

unfavorably all that makes for the maintenance of health. With the knowledge now at hand of the rôle played by focal infections against health, and the organic impairment that they often cause, they should all be uncovered and remedied. Cases of hernia, anemia, nephritis, bronchitis, rheumatism, flat foot, etc., were found as usual. It was considered useful and necessary to refer 15 per cent. of the cases to their physicians. In addition, for those not readily able to pay, almost one-third of the entire number examined were referred to other clinic services for further medical or surgical attention.

It is intended, later, to follow up, in the shops where examinations have been conducted, with occasional health talks and with the distribution of literature in order to assist in the general maintenance of health, as well as to keep a personal contact with employees and conditions of work in the factories in the district. It is hoped to repeat these examinations annually.

In firms where there is already a medical personnel, and where the plant is fairly well covered, it is intended to offer only the extra assistance of the tuberculosis specialists for the examination of doubtful cases which their physicians might wish to refer to the clinic staff.

The New York Tuberculosis Association is assisting in the general educational work, and its statistical research service is utilized for the preparation and study of the records.

An advisory committee consisting of representatives from Gouverneur, Bellevue and Allied Hospitals, the Department of Health, the Association of Tuberculosis Clinics, the Life Extension Institute, the Metropolitan Life Insurance Company and the New York Tuberculosis Association will assist in the development of this tuberculosis industrial experiment. Local labor and business men will also be invited.

CONCLUSION

In New York City, while the general death rate has fallen by 31 per cent. since 1910, the tuberculosis rate has been reduced by 51 per cent. mainly because of institutional, home, family and children's work. With the inclusion now of the wage earner and his place of work in the organized tuberculosis program, the final successful blow can now be struck at the last stronghold of the White Plague.

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The Chairman: We have in this paper, as you have observed, very practical suggestions of how to carry tuberculosis dispensary work, not always in institutional form, to the worker. Very likely some of you wish to ask Mr. Deacon, who is in close touch with this work, questions; but I think we had better run through our program so that we will have our questions reserved until our full program is before us.

Dr. Hawes, will you please come forward and open the discussion for us? Dr. Hawes, as you all know, is the President of the Boston Tuberculosis Association.

DISCUSSION ON PAPER BY MR. DROLET

Dr. John B. Hawes, 2nd, Boston: In the first place I am not an industrial worker; I am simply a plain, ordinary clinician from Massachusetts, interested in diseases of the chest and particularly in diseases of the lungs. But one cannot be interested in those things without being interested in industrial medicine.

I am not good at remembering figures but I do know that the keynote of the paper which was just read consists of practically two words: one—education—two the nurse. In the "nurse", I include the dispensary because the nurse after all is the dispensary and the dispensary without the nurse isn't a dispensary.

Some time ago I was asked to go down and inspect the plant of one of our biggest industries in New England, with about 15,000 employes. I spent the day going through the plant. An excellent high grade physician, two or three younger doctors and some nurses were in charge of the medical work. I came away with certain very definite conclusions. One of those was that if an accident happened to any employee he would be promptly and efficiently cared for. The other conclusion was that they were not even touching the high spots as far as tuberculosis was concerned in that plant.

At my own clinic at the Massachusetts General Hospital in Boston where I have charge of much of the chest work in the Out-Patient Department, there are many employees from this and other plants in and outside of Boston who come to see if there is anything wrong with their lungs. Sometimes they come because they are sent by the physician of their plant but oftener they come of their own accord. Why don't they go to their own physician? The answer, to me, is clear enough, because the average plant physician does not know and is not interested in tuberculosis.

I handed in a report to the manager of the plant I have referred to, which I have no doubt is tucked away in the files, and in this report I didn't ask very much. I suggested keeping track of the weight of suspicious cases. I begged for an annual examination, at least, of certain of those employes who were in the more dangerous branches, and the

answer was: "No, it would scare them. We couldn't do it. We would have strikes and we would have labor troubles."

But there is nothing like trying. Now here is where education is needed, education of the big men who are running that plant, to make them realize that there is one chief industrial disease and that is tuberculosis. There are various funds raised comparatively easily, to investigate brass or zinc poisoning, etc., in industry. But it is very hard to raise a fund of any kind whatsoever to investigate what is the fundamental industrial disease, and I think you will agree with me.

Coming to education, I have been much interested in the methods which were described by the last speaker. Frank Fulton of Providence, something like fifteen years ago, started this work in the big factories of Providence, Rhode Island, and he found out just as we are all finding out, that you must feel your way.

I have had printed, during the fifteen years I was in charge of the State Sanatoria in Massachusetts, a great many pay envelope cards, which are put into the pay envelopes. Perfectly good English is put on these cards but I am sure that most of them are used for lighting the pipes of the employes, and I doubt very much if they are read,

I have been to innumerable exhibits and seen many charts and statistics and I have come away from them wondering why I wasn't dead and why the rest of us are still alive. I have seen many posters telling about tuberculosis. There is a poster of this great Association of ours, the National Tuberculosis Association, a sample of which was sent to me, as President of the Boston Tuberculosis Association. I didn't like it and wrote to Dr. Hatfield and told him I didn't think much of it. It represented a skeleton which was Death being pushed out of the door. I don't think those posters ought to emphasize death and disease. They ought to emphasize health and happiness.

There is a certain gentleman in this room now, I refer to Dr. George Porter of Toronto, Canada, who for many years was secretary of the Canadian Tuberculosis Association, and I might say that *he* was the Canadian Tuberculosis Association. Part of his job was to wander along the little fishing villages of Nova Scotia and New Brunswick. And I know those villages because I have fished and hunted up there. When the winter comes along they nail down the windows and sew the underclothes on to the children and if you mentioned the word "tuberculosis" you would be driven out of the town, I think. That man has spoken to crowded houses up and down those villages on tuberculosis, but never once during his talks did he mention the word tuberculosis. They knew what he was talking about perfectly well; but he knew the psychology of those people and he didn't mention that ugly sounding word. That is what I think we must do.

I hate the word "tuberculosis"; I hate the word "consumption" but I like the word "health." I think our educational campaign among the very ignorant people should be to emphasize a sense of physical pride. Most

of them are developing—and their children too—mental pride. They pride themselves that their children at least, speak, read and write the English language, even if they can't. But we must emphasize the need of a sense of physical pride. We must let every one of those people know that their bank account is their health, and if that stops everything else stops—just as I imagine it is with most of us here.

The nurse? How is the nurse going to get her training?

Answer by J. B. H.: There is an admirable training school at the Massachusetts General Hospital which institution—one of the finest in the world—still holds to the old idea that tuberculosis must not go within its doors. Leprosy, beriberi, typhoid fever, pneumonia—anything else, fully as contagious as tuberculosis, is allowed to enter, while I, a member of the staff of that Hospital, have to camouflage my cases to get them inside: a lung case for study; a question of bronchitis.

How does the average nurse get her training? Is she taught anything about tuberculosis? Probably not. At Rutland they have a fine training school for nurses.

That is one of the problems of the nursing profession, your big problem to take up as an Association: To get a proper training in tuberculosis for nurses.

At a certain large plant outside of Boston there was a nurse. She was a real nurse; she wasn't gathering figures or statistics; she wasn't dealing with cases; she was dealing with human beings. I used to go out occasionally and give a ten minute talk during the noon hour or some other time, to the employes, and I would walk with her through those rooms where men and women and children were working, and it would be "Hello, John, how are you feeling today? Have you got over that cough of yours?" "Where is Nelly?" "Nelly is at home with a cold," and Nelly would be investigated to see what was the matter.

They liked this nurse, she was popular; they would tell her all their troubles, their trials and tribulations, things which they wouldn't tell to the Board of Health or to a gatherer of statistics.

That is the human side of the work and that is the side which appeals to me. But I don't see how we are going to get very far unless the nurse has training. Dr. Miller this morning gave some very plain English about the training of students at the medical schools of this country in tuberculosis. The training of students is conspicious by its absence; and the same thing applies to the training of nurses in tuberculosis. Yet that is the big industrial disease and it still stands as the big problem before us today.

Those are the two points I want to emphasize: In your educational work, leave out the word "tuberculosis"; I like "health clinics" better than "tuberculosis clinics". And find some way so that your nurses get training which they do not now get in tuberculosis.

The Chairman: I am sure we are indebted to Dr. Hawes for bringing this subject to us on the constructive side.

We are fortunate also in having with us a man who has studied this problem from the economic side. Dr. White, well known to us as the Medical Director of the Pittsburgh Tuberculosis League, is going to discuss this general subject further, his special topic being "The Economic Normal in Industry." Now he is going to tell us just what that means.

Dr. William Charles White, Pittsburgh: There are two sides to the question of tuberculosis in industry. We have been largely geared on the basis of getting tuberculosis out of the industry but it is to me a much more important factor to get tuberculosis back into the industry. For many years we have put our tuberculosis subjects in an excluded class.

After one has been pronounced tuberculous the return to the office or the capacity in which that person served before becomes well nigh impossible, especially in the workshop and in the clerical groups.

This latter phase of it, I would like to present to you. I want first to say, however, that I don't quite agree with Dr. Hawes. The nurse is a part of the clinic, but no clinic exists without the doctor; it is utterly impossible; and no clinic exists, to my mind, today without a good laboratory worker. I believe if every clinic in this country would put up the sign, "Sputum Examined While You Wait," we would get further ahead with the tuberculosis movement than in any other single way. But even this is only one part. The idea that we have, nine times out of ten, of having the patient come back with the sputum, or having him wait days for a diagnosis until the sputum is sent to the laboratory—often to state laboratories and city laboratories—is, in my opinion, very bad service. I believe that if in each one of these clinics there were a laboratory worker to make the diagnosis accurately and finish the job up on the first visit of the patient, we would get very much more quickly ahead in the analysis of our problem.

About two months ago I talked with three men all of whom were very much disabled—one of them with advanced tuberculosis and cancer, one of them with advanced tuberculosis and other injuries, and one of them with enormous disability as a result of his researches in the x-ray field. inquiries as to their condition brought the response that they were still able to work; they were still able to support themselves and their families. As the discussion proceeded one of them said, "Well, we are really worth something still in industry."

The other one said, "Well, the trouble with the doctors is mostly that their views are built up on the idea of a physiological normal or an anatomical normal and what we really need today is an economic normal. We need some gauge to be used as the determination of when a man can go back to work at his job and earn his living and support himself and support his family and his children."

So that I think the day perhaps has come when we can include a new normal in our normals and that is the economic normal, a determination of when a man is able to work, and how many hours he is able to work, and our next step is to determine what this is.

I have asked of Mr. Ufford the privilege of presenting this thought to the secretaries, on whom is the great burden of organization, and the burden of educating the vast body of people regarding the prevention of tuberculosis.

There are, it seems to me, two or three very practical implements in our hands. At the first International Congress that was held in America I proposed the use of a night camp. The night camp as a separate implement probably has not been successful. But on thinking it over it seems to me that fundamentally in our tuberculosis movement we have placed our institutions where they are very little used. This isolation has brought with it an inefficiency. I believe that nearly all the tuberculosis institutions should be within the city. Then if they are there, their beds can be used for the principle that was involved in the night camp work.

We have now a fairly large number of patients who have slept in the sanatorium and gone to work in the morning. It means a little upset in the hospital administration but it is a practical, useful thing. I remember perfectly well that on leaving Saranac Lake every doctor except one thought that in going to Pittsburgh while I still had a little fever and open lesion, I was going to what Pittsburgh looks like when you pass through it on the train. On the other hand, it has worked out pretty well, and for fifteen years it has been possible to work.

A man with whose case I was very much impressed recently returned from Denver where he had comparatively recovered. He came home to find difficulties in his family which made it impossible for him to live at home. The utilization of a hospital bed, permission for him to go to work at seven o'clock in the morning and return at three or four in the afternoon, going to bed under the same nursing and medical care which he had had previously, has brought enormous results. As a matter of fact, he did better in his bed in Pittsburgh than he did during his stay in the sanatorium in Denver, and he is much happier working at his own job than at any other job. These are the principles of industrial medicine.

There was an opening for that man in the Carnegie Steel Company, and I venture to say if we can put tuberculosis back into the Carnegie Steel Company as an economic question, that we will have done a very great deal for the economic situation in Pittsburgh. That man has been working now for nearly four months. His superintendent, the whole office force and the factory, his superintendent tells me, are interested in watching him.

It couldn't be done, however, without the personal social instinct of the physician who handles it. It would be utterly impossible, I think, to do it in any other way, and yet all of you secretaries can take the same principle and begin to work it, and get a sympathy in the industries for this group who have to earn their living. We can't go on supporting tuberculosis people always, and it would be demoralizing, even if we could.

As I have a few more minutes, I will give you one other case: A mother and two boys—I might give you one of a mother with five boys, all with active tuberculosis; the question is the support of the family—but I will give you the case of a mother and two boys, one with advanced tuberculosis and the other with tuberculosis in its early stage. The boy with advanced tuberculosis had to go to bed and the mother had to nurse him; the other one was within three months of receiving his journeyman plumbing papers; he had served his term and he was to get his papers within three months. In the judgment of the physician it was possible for him to continue his work if he would go to work at his hour in the morning and return to bed in the afternoon, and stay in bed from that time until he went to work the next morning. His mother was educated to handle him and care for him, with an occasional visit by the nurse from the dispensary; and the whole thing now for a year and three months has worked out perfectly. That boy has been able to support the mother and his brother and himself; the other son with advanced tuberculosis under the mother's care has improved so much that he will be able to go to work this fall. One was an economic normal from the time his tuberculosis was apparent to the examining physician; the other one will become an economic normal from the very moment that he goes back to the industry to which he belongs, and he will return regularly to the dispensary and be watched over a period, as we have now many, many, many cases, examined and watched over a period of fifteen years.

I have been suprised a little that we haven't come to this industrial grouping before. It can be readily shown that it is a matter of economic importance to every employer of labor, and it depends upon your salesmanship of this problem as to how efficient it becomes in its operation. And I am very glad indeed that this matter has come up for discussion before your body.

Dr. Iago Galdston, New York: The discussion of Dr. Hawes and of Dr. White were very valuable insofar as they laid emphasis upon some additional points. I think the point of the paper read to us by Mr. Deacon is so important that it ought to brought back to our minds.

The matter of industry and tuberculosis is one of those few matters that have not been adequately dealt with in the last eighteen years of anti-tuberculosis activity. And yet we must realize, as the statistical data of the paper read shows, that we have come to a point where much more progress will not be made unless we study the matter of the relation of industry to tuberculosis as we have studied the relation of, for example, childhood diseases and the home environment to tuberculosis.

As you read the literature and observe the work that is being done, you find that too much credit is given to and emphasis is laid upon other factors, and that too little thought is given to the economic and industrial factor. In the study of New York, for example, we discovered that certain areas of New York City have a lower, and others a higher tuberculosis death rate. Then we notice, upon further examination, that one

section is inhabited by Jews, and the other section is inhabited by Italians; and offhand, the easiest and most readily suggested answer it that it is racial immunity that accounts for these differences in death rates between the different sections.

But as a matter of fact, if you examine very closely you will find that it isn't so much racial immunity that accounts for the difference in the mortality rates between these different sections as it is the fact that these people belong to different economic strata; and this fact is brought out very interestingly in that we find in Lower Manhattan, chiefly occupied by Jews, one death rate, and in Upper Bronx, also occupied by Jews, a lower death rate. Racial immunity, if it were sufficiently valid to account for the difference in mortality rates, certainly couldn't account for this difference between Upper Bronx and Lower Manhattan, since the Bronx is occupied by the very same Jew who graduated from Lower Manhattan and moved up to there just as soon as he was economically better situated.

Colonel Bushnell in his book "Epidemiology of Tuberculosis" has a very interesting table showing the tuberculosis death rate in Charleston, S. C., dating from 1820 on to about 1900 and giving parallel tuberculosis death rate columns for the Negro and for the white. From 1820 up to 1865 the columns are parallel, the same for the black and the white person; where there is a rise in one race there is a rise in the other; where there is a fall on one side there is a fall on the other side. From 1865, however, when the Negro was given his political freedom but when he became subject to industrial bondage, you find that the death rate for the Negro constantly increases and goes up until it becomes almost four times that of the white man.

Now, if the Negro is said to be especially vulnerable to tuberculosis because of lack of racial immunity, where was his vulnerability previous to 1865?

I merely mention these few points to illustrate the way in which we are neglecting the factor of industry. We talk about the pathology of dust, but we don't study the relation of the work periods in those dust-producing industries and the wages that are being paid to their tuberculosis indexes; and yet I think it is an important fact that many of these men only work four, five and six months in the year, and receive an inadequate wage—a wage that doesn't allow them to secure the actual physical resistance that they need in the form of proper food, rest, vacation and so forth.

I would like to see this idea taken up by other groups and studied further, and developed. I would like to see special emphasis placed upon industry and tuberculosis because as I said before, I am very strongly impressed with the fact that we have come to a point where we won't make very much more progress unless we study the field and get to understand and act upon the relations of industry to tuberculosis.

N. A. Nelson, Brooklyn: The Brooklyn Tuberculosis Committee is approaching the problem of the periodic examination in industry from just a little different point of view. We believe that in industry is to be found the class in which there is the greatest problem of tuberculosis and with which perhaps the greatest work can be done. We feel, however, that instead of trying to entice men in industry to come to our health centers for examination—where we are apt to have too few people to examine at one clinic hour and too many the next clinic hour—if we go into the industry itself and examining as many men in order as we can during a particular period, we will be able to cover more ground. We will in this way, also lay the foundation for an examination in the factory by some representatives of the industry later on.

Not long ago after perhaps two years of foundation-laying through industrial lectures during the noon hours and through my own personal contact with the members of the Personnel Managers' Club in Brooklyn, I was asked by the employes in one industry to come and examine them. They voluntarily went to the management after one of our talks asking for a complete medical examination. We agreed to give the examination and we have completed it.

Since the examination of the men in that particular industry, we have in our hands a request for a similar examination of the women in that industry. We also have in line a shoe industry in Brooklyn, which is contemplating asking for a similar type of examination.

We will make these examinations free of charge for the first three or four industries. I believe, however, as a result of my contact with the personnel managers and their interest in this proposition that it will be possible for us to go to them, after we have secured expressions of opinion from the employes who have benefited from the examination and from the employers, who are apparently very much interested in it, and suggest that next year when it comes time for a re-examination they employ a physician themselves who will examine the employes, but without official connection to the industry so that the employer will not have available the information secured, or secure the services of the Tuberculosis Committee at cost.

We believe that if the Metropolitan Life Insurance Company could save $200,000 on policies over a period of five years by examining a definite group of people and seeing that they secured the proper kind of treatment; we believe that if the results at Framingham can prove that the periodical examination can reduce tuberculosis, as it has, there must be something worth while to the employer, to the industry, in the periodic medical examination; and we are trying to sell the periodic medical examination to the industry as something that the industry can't afford to be without.

Our whole idea in carrying out these periodic examinations free at first is simply to establish our point, after which we intend to offer the services to industry at cost if they can't arrange for facilities themselves,

or try to get a group of smaller industries together to carry out their own examinations.

The Chairman: I think we must all feel that this is a neglected field in tuberculosis work. What we have heard this morning will stimulate us, I am sure, to explore this territory more than some of us have done.

There are two classes of speakers: One, those that need an introduction, and the other those that do not; and Dr. Emerson certainly needs no introduction. He has been doing this pioneer nutrition work for more than ten years and I would like to testify here the debt of Washington to Dr. Emerson's work, through his Institute in Rochester, to which we have sent representatives from here, and through the splendid stimulus of his method, which we are seeking to follow as closely as possible in the District of Columbia.

Dr. Emerson, it gives me great pleasure to welcome you to this audience.

NUTRITION AND GROWTH IN RELATION TO TUBERCULOSIS

By William R. P. Emerson, M.D.

Boston

The statement that almost every child is infected by tuberculosis before he reaches the age of eighteen ought to be accompanied by a further statement as to the effect of lowered nutrition in making active a dormant process. It is fair to say that the prevention of malnutrition means to a great extent the prevention of tuberculosis.

This preventive work must center in the home. We may bring public sanitary conditions to a high level, and overcome many other handicaps of serious import, but unless parents are made to understand the nutritional condition of their children, and how to keep them up to a normal standard of health, other efforts to save them from tuberculosis are largely vain. The task of bringing into the home this kind of health education is one of the things which our nutrition program undertakes to accomplish.

Through the nutrition class a well-tested program, based on careful clinical studies, is applied to the problem. The mere weighing and measuring of the children in a particular school will so focus attention upon the need of better conditions of growth as to bring about a marked improvement while the new impulse lasts. This has led to the organization of many types of classes which make good beginnings, but lead to overconfidence on the part of uncritical sympathizers who feel sure that the way out has been discovered. It is not enough, however, to establish any kind of class, and merely make a good start. The program should be planned so that the underweight children will continue their efforts until they have gained sufficient body weight to sustain their height, and have been trained in food and health habits which will prevent a relapse into their old condition.

The weight-for-height standard has been adopted after long-continued clinical experience as the best single test of nutritional condition that we have. To allow amply for natural variations in type and build, we have worked out a "safety zone" running from seven per cent. under the average weight line to twenty per cent. above it. I have never found a child, or had one brought to me, whose weight-height ratio lay habitually below this zone who did not show other clear signs of malnutrition.

The causes of malnutrition are many and various, but there are few cases which cannot be classed under one of the following five groups: physical defects, especially naso-pharyngeal obstructions; lack of home

control; overfatigue; faulty food habits with improper and insufficient food; faulty health habits. We have tried many programs to overcome these causes, but have secured adequate results only when co-operation has been effected between the four forces which bear an essential relation to the child's health. These four forces are: the home; medical care; the school and other social agencies; and the child's own interest.

In this summary of the "five causes" and of the "four forces" to remove them, the whole ground of the nutrition program is covered, and further discussion is only an elaboration of details. While largely medical, the problem is also fundamentally social, and the home factor is of the greatest importance. For this reason, with the first step in the program we seek the co-operation of the parents. Every child who is found to be underweight needs a thorough physical-growth examination, and we make it a rule that this shall be given only in the presence of one or both parents. Their help is needed in the case history and social examination which follows, and if a mental examination is required it is important that they be fully informed of the results.

When the nutrition class is organized we again urge the presence of the mothers at the weekly meetings, and in the social and medical directions there given they receive the instruction needed in each individual case. Health propaganda and general talks on hygiene serve an excellent purpose, but the actual results achieved through them cannot be compared with this direct co-ordination of medical care with the home.

The physical, mental, and social examinations when made with proper care serve to locate the cause in a large percentage of cases. There are always, however, a small number of children—problem cases—who call for further study such as can only be given in a well organized diagnostic clinic.

The first of the five causes of malnutrition is especially evident in groups of "contact" cases, possibly because the physician who is looking for signs of tuberculosis infection is less concerned with other physical defects. I have found sixty per cent. of diseased adenoids and tonsils in a group of pretubercular children who had been under care for months, and in some instances for over a year.

In no other group do we find more serious disintegration of the home, with a consequent lowering of the standard of control, which ranks second among the causes of malnutrition. The mother's care is necessarily centered upon the patient who is suffering from tuberculosis. Often the very stress laid upon adequate diet for the sick person leads to less care for the other members of the family. The old custom of breaking up the home when the breadwinner was tubercular subjected the children to various influences which did not make for harmony and control when the little flock was brought together again.

In working with families of this class I have been surprised at the failure of those who had them in charge to give training in the essentials of health. For example, a mother who had been under direction for several years for the care of a tubercular husband had not received ele-

mentary instruction in matters of hygiene and food for the rest of the family. She was thoroughly willing to learn, and responded immediately to teaching and suggestions on these subjects, bringing her children up to normal weight within a very short time.

Cases of overfatigue among children exposed to tuberculosis are almost too numerous to mention. This is partly a result of the lack of home control, but also due to failure to recognize that such children are unequal to the demands of a full school program. I have seen children who were on the waiting list of a sanatorium attempting to carry a school program planned for the full energies of a normal well child, and sometimes following extra studies such as music and dancing outside of school hours.

A further word is needed concerning the last of the "four forces" named—the child's own interest. This is one of the most important factors aroused by the nutrition class, and success is almost impossible without it. The child who has come into contact with tuberculosis needs encouragement. He requires training in mental hygiene not only that he may co-operate in the necessary treatment, but that he may not be oppressed with the idea that his family is doomed by the great white plague. The child who is sent to a tuberculosis clinic is at once stigmatized by his companions as a "pip" case. A nutrition class or clinic suffers from no such handicap. This is one of the reasons why a tuberculosis association can work more effectively with children under some other name.

On the other hand, the national and state tuberculosis associations, through the hold which the fear of tuberculosis has upon the public, have acquired a prestige which is an important asset in promoting any kind of health work. Nowhere has our nutrition program been more effectively demonstrated than in the work of the local association of Rochester and Monroe County, New York. The recent exercises in that city, when 120 children were "graduated" with certificates of normal health, mark an epochal step in health work with children.

The nutrition program should eventually come under the board of education, but demonstrations such as this must first be made by private organizations in order to educate the public to support the new measures when at last the municipality takes them over. The position of the local tuberculosis association is particularly favorable for the work through its contact with the board of health and with all the societies concerned in social responsibility for the welfare of children.

The beginning made in Rochester with children of both school and pre-school age very naturally extended itself to the young people who are entering industry. This period of life is one of great strain. The change from the comparatively simple life of home and school to the serious demands of industrial life calls for advice and counsel in the matter of health which few agencies are prepared to supply. The unit of this larger health program is the nutrition class adjusted to meet the conditions of employment. Here, as in the school classes, the weight chart serves as the most reliable indicator of the effect of the day's work on the child's health.

Classes can be established by many organizations and in many places, but a central organization is needed for general supervision and clinical research in order that the best developments may be constantly available. A broad program reaching out into private and parochial, as well as public, schools must be planned to meet the needs of an entire community, and the problems which constantly arise must be met in the right manner in order to gain and hold that public support which is essential to progress and permanency of results.

Up to the present time the teaching of nutrition and growth in medical schools has made little progress. But a start has been made, and it will not be long before these subjects are recognized as a fundamental requirement for all who undertake the problems of the prevention of disease. Our nutrition institutes, held primarily for the training of workers, have proved of value in the general program of educating the public to the importance of this work. Besides "selling the idea" of the value of nutrition work, they afford a means of contact between various organized agencies and persons who have already had training and experience along lines that fit into a broad program.

Results of the spread of these ideas are apparent in many places. In the clinics the main purpose is not merely to determine whether a child is sick, but also whether or not he is growing properly. In the schools there is growing appreciation of the difference in working capacity between well children and those who are underweight, undernourished, and malnourished. In the homes, parents are more and more returning to the practice of watching the child's weight throughout the growing period, instead of disregarding this important factor after the age of infancy.

Another important by-product, if I may use the term, is the reorganization of the home effected through the nutrition class. This is a result of the greatest significance. Through the instruction given to mother and child together we find that when we have rehabilitated a child we have also rehabilitated a home. A spirit of mutual helpfulness uniting parent and child makes for order and sanity. Such a home is a unit of strength in the community. Instead of chaos and anarchy there is a condition of trust and security which makes for right living.

Every one of the "four forces" discussed must be recognized and applied in a comprehensive health program, but the keystone of the structure lies in homes of the right kind. Back of the clinic, the school, the industrial center, the summer camp, the preventorium, the sanatorium —back of every agency concerned in the welfare of children—must be home co-operation. This is the best means of vitalizing child health work, and of preventing malnutrition and tuberculosis. Divorce the home from the other factors, and the greater part of what we are attempting meets with failure. When the child is made well in his own home, both mother and child learn the essentials of health, and through this health education the reconstruction of the home is accomplished.

Exhibit A—(Lantern Slides)

Group I. Photographs showing defects and deformities resulting from malnutrition: Round shoulders, spinal curvature, fatigue posture, ptosis, flat feet, lines under eyes, and anxious expression indicating depression and mental retardation.

Group II. Views of an open air school in Pawtucket, R. I., where 16 children were provided with mid-morning lunches, Eskimo suits, cots for rest periods, playroom, and special teacher. The results of a year's work were a total gain of 2 per cent. less than the average rate of growth for the group because two of the essential forces were omitted, viz. : medical care, with complete examination, and home co-operation with the school program.

Group III. Group photographs of graduates from nutrition classes in the Rochester public schools.

Exhibit B—A Nutrition Class organized by Mrs. R. K. Earle

A class of 14 children used to illustrate various points, among them the following:

A child who had received extraordinary care during infancy, but at the age of twelve was twelve pounds underweight for height. Her mother brings her to the nutrition class regularly, and is very helpful in assisting other mothers to bring their children up to normal. A case of splendid co-operation once the need was known.

A boy, the son of a physician, whose condition was not appreciated until he received the complete physical-growth examination. This showed curvature of spine, fatigue posture, and other defects.

A boy who failed to gain for a whole month during his mother's absence from the city. On her return he made a good gain.

Other children showing malnutrition due to overfatigue from too great school pressure or too many outside interests; also cases due to faulty food and health habits.

Sixteen nutrition classes are conducted in Washington, D. C., under the supervision of Mrs. Ernest R. Grant, of the Tuberculosis Association, co-operating with Dr. Joseph Murphy, Chief Medical Inspector of the Public Schools. A new class is to be started at the Juvenile Court at the request of Judge Sellars.

An interesting report is that of Miss E. S. Bailey, Nutrition Worker, showing the need of rest periods even during vacation. A class of 18 children who were warned against overfatigue at this time, and took their rest periods faithfully both morning and afternoon, gained 44 pounds during a two weeks' holiday. Another group of 18 who did not receive special caution before the vacation gained only 7.7 pounds in the same period. On the return to school the first group lost 9.7 pounds, and the second group 3.6 pounds, showing the effect of school pressure.

Miss Anita J. Turner, Assistant Director of Physical Education, reports 195 colored children enrolled in nutrition classes which are held each week in place of the hour and half allowed for physical exercise.

Exhibit C—Charts

100 charts of the first graduates from this year's Rochester, N. Y. classes.

A city wide campaign is being carried on in Rochester through public, private, and parochial schools, orphanages, summer camps, pre-school groups, and working children in industry, under the supervision of Herbert J. Norton, Physical Director

of the Public Schools, and Mrs. Ethel M. Hendriksen, Executive Secretary, Tuberculosis Association of Rochester and Monroe County.

The Chairman: Our next speaker has very kindly come a long distance to speak to us, from Iowa, where he is director of the Child Welfare Station of the State University of Iowa. It gives me great pleasure to introduce Dr. Bird T. Baldwin.

INCREMENTS OF GROWTH FOR DIFFERENT TYPES OF CHILDREN, WITH SPECIAL REFERENCE TO HEIGHT, WEIGHT AND BREATHING CAPACITY DEVELOPMENT*

By Bird T. Baldwin, Ph.D.

Iowa City, Iowa

I was very much interested in Dr. Emerson's class, and I think what I have to say will be a continuation and elaboration of some of the points which he has brought out in his address.

Before beginning with my subject I want to pay a tribute to the Sociological Section of the National Tuberculosis Association. Four weeks ago there was a little mother in Iowa who was taking care of three little children that had the "flu." The children soon became well again but the mother acquired the disease, which was followed by pulmonary tuberculosis. That little woman was an intelligent woman, she was a college woman; she sat down immediately and wrote to New York asking for literature on the subject of tuberculosis. In a few days the literature arrived, and in the same mail a nice long, personal letter from Miss Drake, the state nurse at Des Moines, showing the wonderful organization of the sociological work of the National Tuberculosis Association. Today that mother is in a sanatorium and is doing well.

My point of view is not that of the sociologist primarily but that of the scientist. I am going to tell you just a little about the work of our nutrition classes, and then I am going to ask the question: *How do normal children grow?* We have heard a good deal about standards of growth for underweight children: how do children grow?

In the first place, we have a nutrition class at the University of Iowa for students. It has been our method to have the experts, the various specialists in the different departments of the University, meet that class and take up the special problems. The students take one course. Then we have the pediatrician and the professor of orthopedic surgery, the professor of nutrition, the dean of the dental college, all of the various specialists, come and give their contribution to the course.

Last year Miss Schuman, a Red Cross nurse, came from New York and conducted the classes for the children, similiar to the one that you saw here today. Next year Miss Maud Brown, of the Elizabeth McCormick Foundation, will come and take charge of classes.

* This paper was illustrated by lantern slides.

We are interested in nutrition in Iowa. The boys and girls in the State of Iowa are taller and heavier on the average than the boys and girls of the United States. They are considerably taller and heavier than the boys and girls of New York State, for example.

We are interested in tuberculosis. During the past year 9000 examinations have been made in our laboratories for tuberculosis alone. So my point of view is essentially that of a scientist, who comes to you with an attempt to give some insight into the investigations we are making on the question of *how* children grow.

You might do a child a very grave injustice to tell him that he is underweight and underheight, unless you are pretty sure of your standards, and unless you are pretty sure of the heredity and the condition under which the child has been living. So we are interested in the normal child and the superior child physically and mentally. We are setting up standards of growth, both mentally and physically.

About twelve years ago I began to investigate the question of how children grow. Since then I have collected data on 2500 children for a period of ten or twelve years, with some thirty to forty physical traits for each child, making in all about 1,500,000 physical measurements on a limited number (2500) of normal or near-normal and superior children. It is the results of this investigation that I wish to present here today. We demonstrate our problems as far as possible by means of the lantern slides.

(*Slide*) The first slide is the picture of a boy that we snapped about two years ago, a little boy that was supposed to be normal. He had been to the County Fair and the State Fair in Prize Baby Contests. He was a little heavy for his height. This little boy, since that time, has had tuberculosis, acquired through cow's milk. He has been sleeping out of doors and he is practically well today.

(*Slide*) The next picture gives an illustration of the measuring of the length of a baby. Dr. Emerson has emphasized today the relationship between the weight and the height. I am much more interested, to be perfectly frank, in the length of a child than I am in its weight. The weight of the child is one index; it is a sort of a thermometer which helps the doctor to understand the present condition of the child. But if you are to know the future development of the child, if you are to know how tall he should be at a later period, and how much he should weigh at a later period, it is much more important to know the length of the child at birth or at some subsequent period than it is to know simply its weight. We must know the length and the weight both, if we are going to take up the problem of nutrition. We must not only know the weight and the length, but we must also know the age and type of the child.

In the few minutes that I have at my disposal, I am going to try to outline to you briefly first how children grow physically; second, the

differences in physiological age of children; third, differences in anatomical age of children; and in the fourth place, the development of breathing capacity or so-called lung capacity, which has a direct bearing upon the great problem of how we shall eliminate tuberculosis.

This is a simple method of determining the height of this particular child. . (*Slide*) This is a normal girl, a girl whose weight is relatively normal for her height. At the time this picture was taken, she was eleven years of age. She had the height and the weight of a fifteen-year old child.

(*Slide*) Here we have some individual growth curves. The vertical direction indicates the height in inches and centimetres. We make all our measurements in centimetres; but the numbers here 55, and 59, and 62 refer to inches. The divisions along this line indicate the age—seven years, eight years, nine, ten, eleven, twelve, and so on, up to eighteen years. These are the individual growth curves of some girls. The measurements were made on nude children; they were made by specialists in physical measurements or anthropometry. The children have had directed play, physical training and medical inspection, and the individual curves represent the growth in height of a particular child. Number 1 is a tall girl who was 55 inches at eight and a half years of age; and she was tall at twelve years of age, at thirteen, fourteen, fifteen, and so on. She was a pupil at the University of Chicago. Number 11 is the individual growth curve of a short girl, who was very short at eight years of age, short at twelve, short at fifteen, short at eighteen.

Now there are a few basic principles of growth which stand out very distinctly when you look at these curves. The tall children remain tall; short children remain short as a rule. The curves have a railroad appearance. Tall girls complete their growth in stature as a rule at about fourteen and fifteen years of age.

This girl (indicating) practically stopped growing after fourteen years of age and we now have her records until she is 23 years of age. Short girls continue their growth longer than tall girls. These short girls at fourteen and fifteen and sixteen years of age are still growing in stature.

The point is this: Tall girls begin their rapid adolescent acceleration at an early age—eleven, twelve, or thirteen; tall girls complete, within a few centimetres, their growth in stature about the time they are fourteen or fifteen or sixteen. Short girls do not begin to have their adolescent acceleration until they are thirteen or fourteen years of age, and they continue to grow rapidly until fifteen, sixteen or seventeen years of age. The point is then that tall children grow differently from short children; and any scale that would measure children by the average of these two would do injustice to both.

If you average those curves, those groups of curves, you are averaging the growth of a child that has completed its growth wth the increment of growth of a child that is at its maximum rate of growth. Consequently, we need different standards for tall children and for short child-

ren. Tall children begin their adolescent acceleration earlier and finish their growth sooner than short children.

These are the weight curves, you see the weights vary more than the height. However, Number 1 is also the heaviest girl, covering a period of ten years. Number 10 is the lightest girl.

When we look at the boys' curves (*Slide*) we see the same thing. The boy that is tall at seven will be tall at fourteen and sixteen and eighteen; and the boy that is short at seven as a rule will be short at fourteen, fifteen and sixteen, and so on. The taller boys have their period of adolescent acceleration earlier than the short boys. These boys have almost finished their period of rapid growth, while these other boys are right in the midst of it. Tall boys grow differently from short boys. These taller boys—and the taller girls—are physically older, physically more mature than the shorter, lighter boys and girls. They reach their adolescent period earlier; they reach their period of adolescent acceleration earlier; they reach their period of final stature earlier.

There are several interesting things that could be discussed in regard to these individual growth curves, and so far as I know no one else has followed the same children, year after year, year after year, for periods of five, ten and twelve years. Consequently, these 2500 individual height curves which we have worked out have direct significance in the study of the problem of how children grow. These growth curves are nearly parallel. In other words, if we would match the growth curve of a child at seven with this series of curves, we could tell approximately how tall the child would be at fourteen.

Another method is to get the coefficient of correlation. Now, everybody is talking coefficients of correlation, and you no doubt know a great deal about the methods. It simply means if there is a one to one relationship,—if the tall boy who is tall at six is tall at fourteen, and the short boy who is short at six is short at fourteen, and this relationship holds true for all the cases—there would be a coefficient of plus one (+.1). If the reverse were true there would be a coefficient of minus one (—.1). If we get the coefficient of correlation at the ages of seven and sixteen for a large group of children, we find that coefficient of correlation is plus point eighty-five or eighty-six, (+.85 or +.86), or even point ninety, (+.90); that is, children, who range high at seven years of age, (or low) range high at seventeen years of age. Therefore, if you knew the group and you knew how tall the child was at seven, you could prophesy with a considerable degree of accuracy how tall the child would be at sixteen or seventeen.

We could go still a little further and apply the mathematical formula of the method of regression. We find that if we get the height of a child at seven years of age we can tell you to within two or three centimeters, how tall that child will be at seventeen years of age, providing there are no accidents, or diseases that will seriously interfere with the child's

growth. In other words, we have come to the point where we can *prophesy in physical growth.* If you will tell us how tall a child is at six years of age, or even how long a child is at birth, we can prophecy to a high degree of accuracy how tall that child will be at sixteen or seventeen or eighteen years of age. And this has a tremendous educational nutritional and sociological value, because if the child is not growing at the prophesied rate, remedial measures may be taken to stimulate growth or to retard growth, whichever may be the necessary type of improvement desired.

(*Slide*) The National Child Health Council met a year and a half ago and proposed that we go into the question of physical growth and formulate standards of growth. I have been working on this problem since and you have here a tentative table. This table is based upon the consecutive measurements of nude children. No child is included who did not have at least five years of measurements. No child is included who was outside a "*normal zone,*" all had had medical inspection, all were measured by trained anthropometrists. No child was included who was defective or had any serious disease or handicaps. Consequently, we took a group of children that were supposed to be normal or near-normal and we worked out standards for height, weight and age. Take a child, for example, 57 inches tall. If he is ten years of age, he should weigh 76 pounds, if eleven, 78 pounds, if twelve 79 pounds, and if thirteen, 82; that is, there is a gradual increase for weight with age, after a certain age, regardless of the height. So, to know the height alone is not quite sufficient. Surely to know the age alone is very insufficient.

(*Slide*) These tables are the product of the thought and conferences of a good many people and they have been adopted by the National Child Health Council and will be at the disposal of the members present in the course of perhaps a month or six weeks.

(*Slide*) This is a sample of one of the Iowa boys who is a little overweight for his height, about one pound. He is taller than the average boy of his age—three years—and he is heavier.

(*Slide*) This simply shows a little pre-school laboratory that we have where we are studying children from two to four years of age. These children come from homes in Iowa City to the University every day for the half day. We are carrying on psychological and anthropometric experiments on them daily.

(*Slide*) Here you have an illustration of a girl who belongs to a superior group. She is taller than the average for her age. She is twelve years old. She has the height and the weight of a sixteen year old child. She is physically developed, similar to a sixteen year old child. There will be another picture later which will show her a year earlier than this. She is socially at the age of a sixteen year old child. She is a normal type judged by her height and her weight and the relationship between these two is in accordance with her physiological age.

(*Slide*) Here are some more individual growth curves. This is a tall girl (indicating); this is a short girl (indicating); the dots show the period of maturation, the period of first menstruation of the girls. The tall girls as a rule mature earlier than the short girls. These conditions are modified by temperature or climate, and to some extent by social conditions.

The point I am trying to make is that tall heavy girls are physiologically older than short light girls; they mature earlier; they reach the period of adolescent acceleration in growth earlier. They are physically older, they are socially older, as a rule.

(*Slide*) This picture shows the distribution for pubescence of boys. There is a wide range of individual differences in the development of both boys and girls during the adolescent period. These results come from near here. They show that some boys are pubescent at ten years of age, some at thirteen, some at fourteen, and there are boys sixteen years of age who are pre-pubescent. Some boys are pubescent at ten, others not pubescent until after sixteen. There is a wide range of individual differences. Some girls mature at ten, some at eleven, some at twelve, and others not until fifteen, or sixteen and in a few instances seventeen years of age.

(*Slide*) The effect of maturing may be noted on growth. We selected all of the girls from the University of Chicago High School, the Horace Mann School, at Teachers College, and our Iowa University School—the girls that had matured at twelve years of age. Those that matured at twelve years of age were growing between twelve and thirteen years of age at the rate of 7 centimetres, on the average, per year; in two years they dropped down to about 1 centimetre a year. That is, early maturity was followed by cessation of growth in stature. Tall girls mature early and the cessation of growth appears soon after. Girls that mature late do not have their cessation in growth until after maturity in most cases. That is not always the case, however.

(*Slide*) Here are four children twelve years of age, chronologically. These children are all the same age chronologically. They have approximately the same I.Q., that is in intelligence they rate approximately the same. Their I.Q.'s run from 132 upward, this girl having a little higher I.Q. than the others.

Physically, they are all of different ages. This boy is prepubescent. This boy is pubescent. This girl is about at the age of maturity and this girl is post-pubescent, that is, she has had her period of first menstruation; she is the oldest physically; and this one comes second, this one third, and this one fourth. Girls as a rule, of course, are older than boys physiologically speaking, from a year to a year and a half, on the average.

This boy (indicating) is mentally alert and has the intelligence, the I.Q. equivalent to the others, generally speaking, but he is mentally young; he is in the eighth grade. This boy is in the ninth grade. This girl is in the tenth grade, and this one is in the eleventh grade. They are all chrono-

logically the same age; they are all, as far as intelligence is concerned, about the same; physiologically, they are all of different ages; and pedagogically they are all in different grades. Socially, they are all of different ages. It would be a crime to put this little boy up into the eleventh grade; and it would be just as much of a crime to put this girl back into the eighth grade.

So let me suggest one note of warning: We cannot afford to promote the children on their I.Q.'s alone as is being advocated in this country in a very broad fashion. We have to take into consideration the physiological age of the child; we have to take into consideration the social age of the child. One index of the physiological age and the social age is the height of the child and its weight.

(*Slide*) Another method of testing physiological age is to take an x-ray of the wrist. I now have 350 of these x-ray pictures. You have here the picture of a little child who was a year and a half of age—my little girl. She has two bones in her wrist. When she gets to be fourteen, she will have eight bones in her wrist, but at present she has two.

(*Slide*) The next picture shows one of my twins, five years old; this boy has four bones in his wrist. (*Slide*) The other twin has seven bones in his wrist. The latter is taller, heavier, older physiologically speaking today than the former, although chronologically he is the same age. The point I am trying to make is that children of the same chronological age may differ tremendously in their physical or anatomical age.

(*Slide*) Here is a boy about eleven years of age. (*Slide*) Here is a boy thirteen years of age. Now, the eleven year old boy is older, larger, further developed, anatomically speaking, than this thirteen year old boy. Consequently in judging his height, in judging his weight, in judging his school progress and his social activities, we should take into consideration the anatomical age of the child. One of those boys is prepubescent; the other is post-pubescent. The younger one is the post-pubescent one.

Just a few further facts about the physical development of children: If we are going to prevent tuberculosis in adults, we should try to develop the *breathing capacity* of our boys and girls.

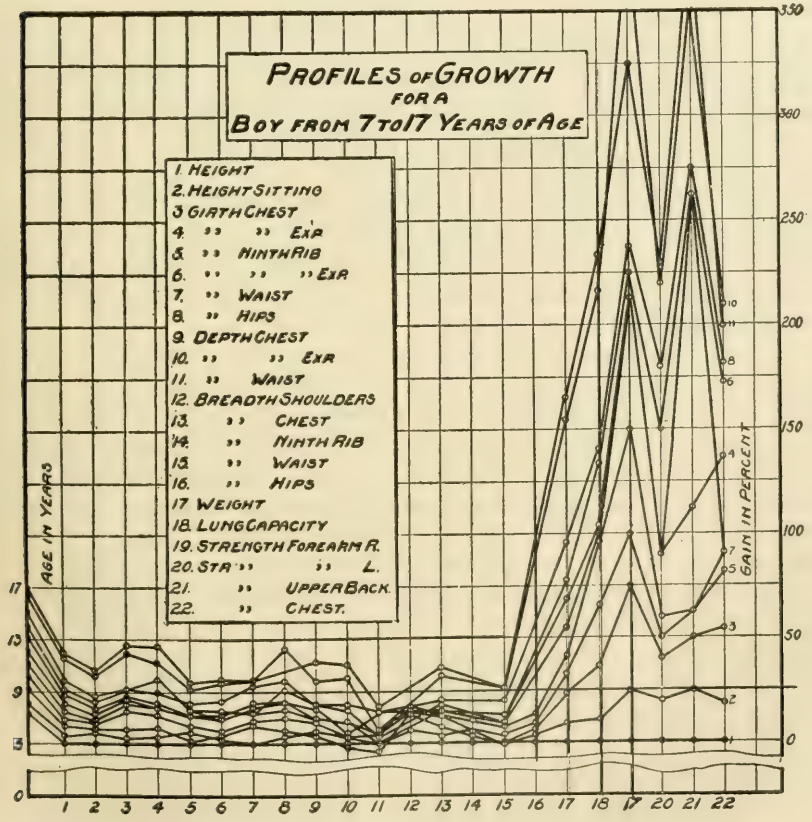
(*Slide*) I am told on pretty good authority (one article is in the last number of the magazine of the *Journal of the American Medical Association** that the children with tuberculosis fall from 40 to 50 per cent. below the norm in breathing capacity. Consequently, every doctor who examines a child should take into consideration its breathing capacity; and every school should have some means of checking the breathing capacity and the growth of the breathing capacity of the boys and girls.

(*Slide*) We have just started to work out a height breathing capacity table, which is being made for the National Tuberculosis Association. We find that there is a closer correlation between growth in height and breathing capacity than between growth in weight and

* J. A. M. A., April 15, 1922.

breathing capacity. If we can get such a table it would be of wonderful assistance, since no reliable breathing capacity tables exist. We have here the results of 40,000 measurements on 2500 children in breathing capacity, and we have here the beginnings of a table which will be completed in the course of a few weeks, which tells what the breathing capacity should be for the height and age of the child. We shall work out the same thing in regard to the weight of the child.

(*Slide*) Here is an interesting chart which simply shows the growth of one child from seven to seventeen years of age. I have at least 500 of these charts worked out. This boy came from the Sidewell Friends School here in Washington. They kept a very careful record of him since the time he was seven years of age up to seventeen years, and you have here 22 traits. And if we can take the height and the weight and the breathing capacity and all these measurements as 100 per cent. at seven years of age, we get the per cent. of increase at seventeen years of age. Breathing capacity is indicated by Number 18. This child gained



Percentile growth during ten years of consecutive measurements.

from the time he was seven to the time of seventeen years, 240 per cent. in breathing capacity. Boys as a rule gain more in breathing capacity than girls. The greatest gain in breathing capacity comes during the adolescent period. The taller heavier boys have their adolescent acceleration in breathing capacity earlier than the short light boys. Boys continue to develop in breathing capacity as a rule until they are seventeen, eighteen or nineteen years of age. Girls begin to drop off in breathing capacity at fifteen years of age.

(*Slide*) The next curve shows simply a sample of two boys with normal breathing capacity. This boy (indicating) is eleven years old; this boy is nine. This boy has the average height of an eleven year old boy and the average weight; this boy, you see, is taller and heavier than the boy who is eleven years of age; his weight is in proportion to his height. He looks there as if he is under-weight but as a matter of fact he is eight pounds overweight for his height, because he is very large-boned and bones weigh considerable even in boys. (*Slide*) Here is a girl who comes pretty close to a normal standard type. She is eight years old.

(*Slide*) Here we have the chest girth measurements. We have not found a very close relationship between chest girth and breathing capacity, especially with girls. The curves take a decided turn during adolescence and so far as breathing capacity is concerned, we get a very poor insight into the breathing capacity by simply taking chest girths. The measurements are very inaccurate as a rule, anyway.

(*Slide*) This shows the breathing capacity curves of some boys. See how the curves shoot up during adolescence. These are individual breathing capacity curves of some Horace Mann School boys, showing the cessation of growth, or dropping off of growth from the ages of nine to thirteen and then the rapid growth later on.

(*Slide*) These two curves happen to be the curves of two brothers, and one was considerably larger than the other. The breathing capacity curves take a somewhat similar trend. Both are slightly below the average for this particular group of children. The breathing capacity measurements have a mental factor which the other measurements do not have. They are called psychophysical measurements, and there is always a question of the voluntary effort of the child being included. (*Slide*) These are two brothers again who are closer to the norm. There is a very close relationship between the growth of brothers, even though one may be considerably taller than the other.

(*Slide*) These are also some growth curves of boys in breathing capacity. You see the rapid growth during the later ages.

(*Slide*) These curves are technical curves which show the relationship between one physical trait and another, and we have worked out by the coefficients of correlation on the same children seven years of age, and eight, nine, ten, eleven, twelve, and so on up to seventeen, the inter-relationships in the growth for the physical traits; and this gives the relation-

ship between breathing capacity and height, the coefficient between breathing capacity and height. The coefficient of correlation as you see is about point eighty (+.80) and never drops below sixty (+.60); that is, there is a very close relationship between growth in height and growth in breathing capacity. For weight it is considerably lower, and for the strength tests still lower. Boys grow more regularly than girls. If you will notice these curves at the top of the chart, all of the coefficients of correlation among different physical traits of boys are higher as a rule than for girls.

(*Slide*) This is the last curve and it shows you the *mental growth* of children. We have been working for several years with the same children and we have now six consecutive intelligence tests, on the same group of children; and so far as I know, this is the first time that an empirical mental growth curve has been presented. The physical development of the child is of primary importance, not only in the home, but in the school. There are the mental growth curves of superior boys and superior girls; that is, boys and girls with an intelligence quotient of 110 or more. And here are the mental growth curves of average boys and girls, that is, boys and girls with an I.Q. of 90 to 110. There is a slight divergence in the curves. Superior children become a little more superior as they grow older according to these curves. There is a close relationship between physical growth and mental growth. The mentally superior children are also physically superior, on the average.

There is also another relationship between the mental and physical growth. There is a period of adolescent acceleration in the mental growth of children, at the ages of from eleven to fourteen; with the superior girls this adolescent acceleration (of superior girls)—the dotted curve is the girls—appears at eleven years of age; with the average girls it appears about twelve. With the superior boys it begins at thirteen, and if our curve continued it would probably show that with average boys the adolescent acceleration in mental growth begins at about fourteen.

In other words, these records show that there is a close relationship between stages in mental growth and stages in physical growth. They show that children that are superior mentally as a rule are older or superior physically. They show that there is a wide range in physiological differences among children of the same chronological age. We are ready to start in on a campaign for the development of the breathing capacity of boys and girls in America in order that we may reduce, as you have done so effectively, the number of tuberculosis patients in this country.

The Chairman: I am sure you feel, as I do, that we are exceedingly fortunate in having these original studies presented to us. We feel it a distinct honor to have listened to a scholarly address of this kind. I will ask Mrs. Hendriksen, who has done so much in working out the Institute idea with Dr. Emerson, if she will open the discussion. Mrs. Hendriksen.

DISCUSSION ON PAPERS BY DR. EMERSON AND DR. BALDWIN

Mrs. Ethel M. Hendriksen, Rochester: The nutrition class program as developed by Dr. Emerson is the most satisfying work which was come to my attention in eleven years of organized tuberculosis work.

We have had classes in progress in Rochester in public and parochial schools and in the rural schools of the district of Monroe County for two years and we feel exceedingly satisfied with the results obtained and with the developments which are still promising.

Dr. Emerson contrasted the open air school with the nutrition class; we have had definite experience in this connection.

Our association established an open class at Rochester as one of our first objectives. This class was in progress for three years and practically the same children remained in the class at the end of the third year as were admitted to the class at the beginning. After Dr. Emerson opened his nutrition work in Rochester with an Institute which gave us trained workers for the nutrition classes, we adopted the nutrition class program for this open air class, together, of course, with establishing many other nutrition classes.

In the period of four to five months following the establishment of the nutrition class plan for the open air class, we were able to graduate a large number of those children who had been in the class for three years and who practically had made no gains. The gains made under the nutrition class program were three times as great as under the open-air class plan formerly followed. It was pointed out to us very definitely that our mistake in the past had been in neglecting the correction of physical defects in the children, many of which were obscure and not discovered by the school physician, and in neglecting to secure the co-operation of the home.

When these two faults in our program were corrected at the direction of Dr. Emerson, we obtained results. So that we feel now that the nutrition class is a very much better approach to the problem of the undernourished child than the open air class. We want open air, of course, for all children but it is not necessary to have open air classes in order to bring children up to weight, and it is a very costly way of doing things. The nutrition class will bring the results in much less time and in a much better way.

We have been conducting a summer camp for children for the period of three years, and when we adopted the nutrition class plan for our summer camp, our gains in weight were nearly doubled. We, of course, chose children for our nutrition camp who were not making satisfactory gains in the nutrition classes; and that meant that those children presented a much greater problem than the average underweight child. Irrespective of that problem, the children in the nutrition camp were brought up to weight in practically every instance where we were able to keep them long

enough, and we were able to determine through that experience that lack of home control had been the chief obstacle.

Now we have taken the nutrition class program a little farther and have placed it in our Health Crusade work, and we find that we are securing much better results than heretofore.

Dr. Emerson's plan checks up our old methods and rounds out our programs in a way which I feel is very satisfying.

The nutrition class plan as we have found it is not simple; that is, we do not feel that any untrained person can go in and conduct a nutrition class. We have held two institutes. It was interesting to see the number of persons who registered for the second institute, persons who had taken the first institute and were eager to take the second. To conduct the classes is to discover one's lack of knowledge. We find that it is absolutely necessary for workers to be well grounded in the nutrition class program before results can be obtained. Our classes this last year made infinitely better progress than the first year when our workers were not as well trained or as experienced.

It is important in developing the nutrition class program to secure wide community cooperation. The tuberculosis association cannot get results working alone. In the first place, we were fortunate in having the Board of Education take up the work at once, sending some fifty teachers to the institute, paying their tuition fees, and the work being incorporated at once with the Department of Health Education, and classes being established under the direction and with the authority of the Board of Education. This gave the work immediate prestige in the community. Our association developed classes in the parochial schools. We have not yet worked out a plan whereby we can turn these classes over to the parochial schools but we hope that that will be one of the developments in the next year or so.

It is our purpose to organize and inspire the community and, as Dr. Farrand said last night, to conduct the public education, more than to do the actual nutrition class work, for an indefinite period.

Also, we were able to secure the cooperation of the Health Bureau, and then of the various social agencies in the community, all of which are exceedingly helpful and necessary in carrying on this nutrition program.

Our Dental Dispensary has been very helpful to us; our hospitals have established diagnostic clinics for us; our community chest financed a special tonsil and adenoids clinic, in which a large number of children were operated. This work is now being carried on by the hospitals, and the Dental Dispensary. Our nose and throat specialists are cooperating with us and we have a very good contact, we feel, with our medical association; we feel that many physicians have an understanding and appreciation of the work. Our tuberculosis sanatorium is interested. Our medical superintendent, Dr. Lloyd, is very helpful in this work, and so is Dr. Wolcott, the president of the board of managers. Then we have been very fortunate in having as our director of nutrition class work, Dr. Mary Moore Hoyt.

It was really very gratifying to us to find the interest in the parochial schools so keen. Some of the pastors were very helpful in their remarks in stating that health is more important than education and that this work is meeting a great need.

Lack of home control constitutes our present greatest problem. To meet this we have the promise of the cooperation of the Home Bureau of the City and the Parent Teachers Association and the Women's Clubs, in organizing what we shall call a Parents' Week to be held early in the fall at which time we shall have lectures by specialists who have made a study of the problem of helping responsibility to function more definitely.

The by-products of this work are constantly cropping up. It is amazing how the malnourished child mirrors all the ills of the community! Are our school programs too heavy? Is the home supplying the anchor the child must have? Is the family physician finding the defects? Are the children themselves realizing that health is priceless? The nutrition class brings these four interests together and coordinates them for the benefit of the child.

Our further developments in connection with the nutrition class program include the establishment of classes for children of pre-school age and for the establishment of classes for young workers in industry. We have the promise of the cooperation of two of our large factories, one factory employing 18,000 workers, the other 5,000. Both are very much interested in seeing this work go forward.

The Chairman: Keep your eye on Rochester, and if you want to know what Rochester is doing get Mrs. Hendriksen to send you her most interesting monthly bulletin, which is one of the most valuable bulletins that come to my desk.

We haven't time to carry on further this interesting program; I wish we had, but our time is up.

The next topic on the program is "A Community Program for the Tuberculous and Exposed Child." One of the things which suggested this subject this morning was the result of a questionnaire which was sent out to the state secretaries, by the National Association some time ago. In this questionnaire the state secretaries and some of the city secretaries were asked to tell what the policy was in their respective communities regarding the treatment of the undernourished child, regarding the treatment of the child living in a home where there was a focus of infection, the contact case, and regarding the treatment of the child pronounced to be actively tuberculous.

I am sorry to say that the compilation of those questionnaires showed that we hadn't thought the thing through, and I hope that as a result of our conference together this morning we are going to classify our thinking, and that we are going to try to develop a definite program which which shall have behind it real scientific authority, because I believe that it what we need; and we also need to know the best that is in sociological practice.

We know that the Elizabeth McCormick Memorial Fund of Chicago has done a great deal of practical work, in the field of the open air school for the undernourished and what we sometimes call the pretuberculous child, and latterly in the field of nutrition. Mrs. Wood has been kind enough to come to Washington twice this winter to talk about the nutrition work that that Memorial Fund is now concentrating on. Unfortunately, she could not be with us this morning, unfortunate because of the reason for her absence, which is an illness that prevents her from coming. But she has been good enough to send us her associate, Miss Murphy, and we will have the pleasure this morning of listening to the Associate Director of the Elizabeth McCormick Memorial Fund. Miss Murphy.

THE CHILD AND TUBERCULOSIS—SOCIOLOGICAL ASPECTS OF THE PROBLEM*

A Community Program for the Malnourished, the Actively Exposed and the Open Case

By Mary E. Murphy

Chicago

The subject to be considered today by this Association might well be "A Community Program for the Malnourished, for the Actively Exposed, for the Open Case, and for the *Well Child*," for until we have a community program for the well child, to keep the well child well (as infant welfare programs keep infants well), we shall continue to have these first three classifications to deal with from the sociological and the medical side.

Of course, your Crusade work is making a very splendid attempt to do this very thing. The Child Health Organization and other child welfare organizations are realizing the fact that we must have school programs and community programs to maintain a health standard for those who are now well.

Nevertheless, we have this problem, the malnourished child and the tuberculous child, and since it is really the result of a failure on our part as social agencies, either as actual social service agencies or as schools, to function properly and to see that the home functions properly, it is primarily a sociological problem. It is being recognized as such by the social service agencies. The child who comes into the juvenile court frequently represents a social maladjustment which had its beginning in physical maladjustment. The children of pensioned mothers and those carried by the charities present a double problem, if combined with the need for relief and social readjustment there is also a debilitated physical condition.

Social settlements are coming to see that besides furnishing a place of recreation their centers afford a marvelous opportunity for a survey of health conditions among children and for constructive measures to meet the needs disclosed.

The Boy Scouts and Girl Scouts and Campfire groups, the playground centers, and the parks are finding that one of their functions is certainly to deal with the malnourished child.

* From the Elizabeth McCormick Memorial Fund.

We have been having contact with the juvenile court through the pension department and have been conducting nutrition classes for the malnourished children of pensioned mothers. The problem is not a problem of poverty, as we now know; it is a problem of education. These mothers come, most of them—some of them are working and cannot come every week, but they come every week, if possible,—to the class, and there are taught through the class method what their children really need, the things that are essential, and they are providing these things. The success with these children of the pensioned mothers is quite as great as the success with those from well-to-do homes, where there is little difficulty in providing the necessities of life.

We have during this last year, at the request of the United Charities, begun cooperating with the Allowance Family Department. Every month the children are weighed. They comprise a large number, varying of course, from month to month because many of them are carried only until pensions are granted. They are given a record of their weight to take home, together with instructions as to measures necessary for their improvement. Many times the mothers come with them. Those children, then, who are found to be malnourished are referred to existing nutrition classes, or, if they are under six, to the Infant Welfare Society, for special nutrition work; or upon examination, which we always follow up with after weighing, they are, when necessary, referred to dispensaries or to hospitals, or to places that will care for them, since, of course, practically none of them can provide a physician of their own.

The growth of such work in the social service field is already tremendous, but should be greater still. It is right in line with the present day ideal for social service, which is the full development of the capacity of the family. As some one has recently put it, "Every family has both assets and liabilities; is both rich and poor." We all of us have been dealing too long with just the liabilities. This attempt to make a survey of the entire family, of the pensioned group and the allowance family group, whether they be well or sick, and to take care of those who are not perfectly well, is an effort to develop the assets of the family, to develop its full capacity.

So any community program for the malnourished child should certainly include work through and with the social service agencies in the field, and should point the way to those agencies to develop the full power of the family from the health standpoint.

The settlements have done splendid work in their development of the recreational capacity of a neighborhood, attempting to bring into that center all the groups that can be developed from the social standpoint. It is a question, however, whether in their very desire to provide activity they have not sometimes failed to understand fully the physical conditions and needs of the many children who visit them. Within the last two or three years the Elizabeth McCormick Memorial Fund has been cooperating with several settlements in which there is a realization

of their responsibility for the health of the people who come to the center, and of the opportunity which the very nature of its activity creates for reaching large numbers of people with health education. In one of these the head resident, becoming especially concerned with the problem of malnutrition, asked that a health survey be made of all children taking part in settlement activities. Since the weight-height relation is a safe index (although we do not think the only one) and an excellent means of taking a first inventory, to be followed, of course, by a more thorough physical understanding, we weighed and measured all the children coming in for the various clubs, and placed those especially underweight in a nutrition class. A complete physical examination was given the children in the class, and the nutrition worker and a resident home economics teacher cooperated to make the weekly lessons function actively in the daily habits and dietaries of the children in their homes.

A health survey of this kind challenges the over-activity permitted many children in these centers. Hundreds of children, no doubt, are going into all the settlements of our cities taking part in activities for which they are physically unfit. One little girl was found to be 18 per cent. below weight and you didn't need to weigh and measure her to note her poor physical condition; you needed only to notice her pasty color, her look of dejection. Perhaps the look of dejection was interpreted as indicating a need for further social activities. At any rate, it was an honest desire to give happiness that had made it possible for this child to take part in so many holiday activities that she was at the settlement every afternoon and evening for weeks before Christmas preparing for the festivities. And yet, soon after that she was found 18 per cent. below weight, with other signs of malnutrition as well.

That settlement, together with others, is realizing that there should be a health standard and some measure of the nutrition of the children among whom social activities are being promoted.

At one center a physician examined the children who came in for aesthetic dancing and clubs in an attempt to determine whether the children were being socialized at the expense of health, or with a recognition of its value as an important factor in the process.

So a community program must take into account the social settlement activities and convey to these centers a health standard for the children. It would be very simple to do this; it is so easy to create a goal for this health work. If children are eager to be in plays, to be in all sorts of activities, how easy it would be to say: "There is a health standard you must come up to, as the soldiers had to come up to a health standard. If you do, and we will show you how (of course that must be provided) you may take part in this play, or you may go into this contest," whatever it may be. It is not an impossible thing to take care of. It merely presupposes an ideal of health.

The nursery is another field and of special interest because it deals with the pre-school child. Here, then, is another opportunity for de-

veloping this thing I spoke of a few moments ago: the assets—the full capacity of the family. These mothers, most of them, are working mothers, and need guidance, and the children who come into the nursery are many times in very poor physical condition. Is the nursery contributing to their health or is it simply accepting them in the condition in which they are admitted? There is a marvelous opportunity for the day nursery to become one of the greatest educational centers serving especially the economically needy families.

In the same way, of course, the kindergarten—I am going to speak of the school later—should be one of the greatest educational forces for the health of the children of pre-school age. Infant welfare stations in many cities, as fast as they are financially able, are taking into their stations children not only up to two, which used to be regarded the end of the infant age, but children up to six, for special nutrition work.

I should like especially to speak of the playgrounds in relation to nutrition. They are failing, or will be failing, to contribute to the health of the children, and this is really their ideal, if they do not realize—as settlements must realize—that there are great numbers of children who are physically unable to enter the games and the activities which they are entering, many of them, 18, 20 per cent. and more, below weight. There should be, and there could very easily be, a standard set up, just as in the settlements, which would create a goal toward which these children coming in could work, and that in itself would be a tremendous educational factor for the playgrounds to have.

The Girl Scouts and the Boy Scouts have in the strength of their organizations a tremendous force for health. The ideal for service, the team play appeal, can be so drawn upon in the promotion of the health ideal that personal health achievement becomes the chief pride of a good Scout, and no Scout or Campfire organization has fully realized its own capacity until it not only holds up the health ideal for the group, but also takes stock of its members individually and knows that no underweight and undernourished boy or girl is within its fold unrecognized and uncared for.

Last year at the request of the Girl Scouts of Chicago we weighed and measured all the Scouts before they went to camp. In the process of weighing we found one girl, 17 years old, who was 43 per cent. below weight for height. Now, regardless of how you may feel about the various weight standards, whether you think they are too high or too low, you will agree that certainly 43 per cent. below any standard on earth means a serious difficulty—if not medical, social.

The girl was given a physical examination, a very thorough one, and it was found that she didn't have a single physical defect that apparently could interfere with her nutrition, but that her whole regime was wrong and she had absolutely no health standard for herself. She lived with an aunt and she and the aunt didn't get on together at all. She didn't obey the aunt and the aunt resented it and it was one constant nagging

from the beginning of the day to the end. Following the examination she was given definite instructions about giving up tea and coffee, which she was drinking, about substituting milk instead, about the extra rests she needed to build her up, and was finally sent to the Scout camp. She had been resentful toward every bit of advice that was given her, but when she went to camp she found herself a great deal happier if she fell in line with the rest. Before long she was eating, sleeping and exercising like any normal girl. I saw her about two months ago and I had to be introduced to her; I actually did not know the girl, she had changed so. She is now, I would say, a social asset in every sense of the word, a very beautiful girl. The day I first saw her she was a sight. She was tall; the word that at least we Chicago workers know so well in certain districts—skinny—applied to her. She was indeed skinny; she had been wearing that day high French heels and she looked like an elongated French heel. When I saw her two months ago she was a beautiful girl, interested in life, with a standard of health which means as much as her physical improvement itself. The Scout ideals now mean what they should to this girl, because she has reached a degree of health which gives her a normal point of view.

These forces in the community, and others which I have not named, should be marshalled by any group making a campaign for better nourished children, because so long as there are children not cared for properly in the home, or not cared for by the school, there will be need for work on the part of all the agencies that exist. But the great social agency to deal with this problem is, of course, the school. We are touching but a fringe of the problem until this is admitted into the school by the school authorities as a big educational factor, and furthered by the teachers themselves in the classrooms. And in that program of the promotion of a health concept within the school, there will be for many years need for agencies such as that represented here to do pioneer work, to point the way, developing this work gradually until it is taken over by the school.

In the promotion of its work, the Elizabeth McCormick Memorial Fund sees within the school itself two problems and two methods of treatment: One of them is the need for general health education of all children, those who are underweight and those who are well and should be kept so. In this program such items as the following have been successful: regular weighing and measuring, the giving out of tags such as the Bureau of Education tag, the yellow one, or these tags (the white for the average, the blue one for the border line, and the red for the underweight child), the sending home of letters telling the parents what the condition of the children really is and what daily regime should be followed to maintain health, the promotion of health exhibits and food exhibits, the development of educational work among the teachers themselves so that they see in the curriculum possibilities for furthering this health work—all of these are educational and social fac-

tors which will further the nutrition of a large per cent. of the children.

There will remain a percentage of children who are primarily medical problems, and for these there should be provided complete physical examinations and if possible nutrition classes, which afford opportunity for an intensive study of the children for whom mere instruction and less frequent checking are not sufficient to insure gain. The weekly meeting of a class such as you saw yesterday provides a careful check on the child's regime and together with the medical understanding furnishes a fairly complete diagnosis of the problem.

In two school systems of about 6,000 each, where the Elizabeth McCormick Memorial Fund is doing work, the work is conducted on a plan of this kind: weighing the entire school group, giving tags, classifying the children, as many of you are doing, into different groups: the average, the border line and the underweight; telling the home about it—and that is absolutely essential—in printed material and by parents' meetings, by frequent friendly communications, and getting the home busy on it. That, I should say, is the crux of the whole matter, and if we fail to do that we have placed the whole responsibility on the child, and that isn't fair. We are having exhibits under a specially trained person, a health educator, in each of these two centers, who is also training the regular teachers to carry on vitalized health instruction in the classrooms. At the same time we are conducting for the children who are so malnourished as to deserve special attention, demonstration nutrition classes which meet weekly, and for which the complete physical examination of each child is the foundation. Physical defects are being remedied as fast as possible, and the children are being made free to gain.

Those factors in the community that are necessary for cooperation in this work are, of course, many. In your school itself you have the home economics department which should be brought into play, which can make such a valuable contribution in the training in foods and their relation to health. In the two community demonstrations I spoke of this phase of the health program is being carried by the home economics teachers.

The physical education department has to be brought in; otherwise you are pulling against a great load. In one school which I know well the nutrition classes had in them boys and girls who were taking active part in physical exercises, although they were 15 and 20 per cent. below weight. It was at first very difficult to get them excused from this work. There are, of course, physical education directors who see that exercise does not serve the needs of all children equally well, and in many cases credit is being given for rest periods by the physical education department itself, instead of for physical exercises, provided the child is carrying out other requirements.

Next, the school itself must be readjusted to meet the physical needs of the children, if we are to deal adequately with this community program. The hours are far too long for most of these malnourished

children and a modification of the program must be made to give them any chance for health.

The school should make possible a milk service in the school, morning and afternoon, or morning at least, so the children may buy it. I do not think it is advisable at all to have it given to the children; the educational factor in the serving of milk is practically lost if no charge is made. The children should be educated to buy this milk instead of buying candy.

Just before I came on to this meeting I heard something in regard to two families we have dealt with which encouraged me in the belief that such education does sometimes bear fruit. The children were members of nutrition classes, but milk could not be provided since the mothers were awaiting pensions. They were, therefore, carried on a list for free milk for several months. One of the dairy companies delivered it to the homes, a private fund paying for it. When the pension was finally given them, these two families continued with exactly the same amount of milk, though they were then paying for it themselves, for they were convinced of the necessity. A milk service should be accompanied by education as to its value.

Then, as a direct factor in the nutrition of children there should be provided, in the school itself, an adequate lunch for the children who have to stay there. This is especially true in the rural sections, or in the cities where the children live too far to go home at noon.

Perhaps the foregoing covers in general the chief points in a program for the malnourished child. There remains the phase of the subject relative to the actively exposed and the open case. I do not feel at all qualified to speak on the open case and do not intend to do so. The only thing I wish to say is that we feel very strongly that the open case does not belong in school, that such cases should be cared for in a sanatorium, or, if at home, under supervision. They are primarily medical cases and should not be made the school's problem.

Those children who have been exposed to tuberculosis through some member of the family, who perhaps are anaemic or malnourished, or in a debilitated condition, are in school now and may remain there provided we create favorable conditions. The question is: just what type of school is favorable to this group?

There are certain factors which should be provided for these children. First, of course, is medical and nursing care; a physical examination given to every child who is admitted, and periodically during his stay in school; and a nursing service at the school, reaching from the school into the home, to secure cooperation for what the school is trying to do. Next, at the school nourishing food should be provided, and there again the question arises as to whether this food should be given or sold. We feel, as a result of our experience, and of observation of open-air conditions and administration throughout the country, that the best thought on this subject is that the food should be paid for or partially paid for by

those children who are able to do so, even a few cents, and those children who absolutely cannot pay must, of course, be taken care of quietly.

There should be provision for rest in these schools; and, of course, there should be air. Now, the thing I should like to say about the open-air and open-window rooms is that if we had the right conditions in the schools themselves, and adequate provisions for health and health teaching for all children, but especially for the underweight and malnourished children, we would have very little need for special open-air and open-window rooms, as we ordinarily understand the terms. I think that it is an almost amusing contradiction that in a building where there have been one or two or three splendidly conducted open-window rooms, right next door there are hermetically sealed rooms, so stifling that you wonder how anybody can live in them! There is no question that there should be found in this contradiction a real function for some committee from this organization to get busy on this question of the ventilation in school buildings, to give earnest thought to the children who are in need of air, who are in need of the program we have just described, or who *will* be (shall we wait until they *are* before we take care of them?), unless we work for better conditions throughout the school.

All the things which are found in the best open-air and open-window rooms should be provided for every child in every school, but especially for the malnourished children, of course. Here is a field for the prevention of tuberculosis. We need to campaign for air. I would say while we are campaigning for air coming in through the windows, let us by all means campaign for air in the curriculum which will allow more relaxation, and the possibility for a health ideal in the school. We cannot, so long as we have the type of school programs we have in most schools, expect to have a health program function as it should.

Where there have been failures of open-air and open-window rooms, they have not been so much medical failures, I think. Perhaps it is true that we haven't paid enough attention to the removal of tonsils and adenoids and other physical defects, thinking if we put children on this regular open-air program they must get well. I think the failure of the open-air and open-window room, if it has failed—and by that I mean it has not developed its full capacity,—has been sociological. We have failed to reach the home adequately to make it function as it should; and, second, we have not made use of the educational viewpoint in reaching the children in the open-air schools. We have set up these open-window and open-air schools and then have expected that the children would get well; and the mothers and fathers don't know what we are doing. And if they do know what we are doing, they don't know that it is much better than what they were doing.

There is a lesson to be learned from the nutrition class regime, which expects the mothers to get in touch with the class and to shoulder the responsibility of getting the child well within the home itself. However poor the home, the essentials of health are there, and the most important

part of the work of any open-air school or special class is in making these essentials function. This is achieved only when the parents are in direct touch with the efforts of the school and when the children are aroused to an enthusiasm for health.

If this is true, the place for the open-window rooms is close to the homes of the children needing them. There are cities that have set up marvelous institutions for the care of the actively exposed or of debilitated children, but too far removed from the homes of the children. I know of three families that travel an hour and a quarter to get to one nutrition class. It is very questionable if the benefit derived from the weekly visit to that nutrition class is great enough to overcome the effect upon the whole family—and they are poor—of the expense of the carfare, the long trip with the nervous strain on those children. Well equipped and well run open-air schools—whole sides of the building open perhaps, with cots, blankets, etc., with splendid food and splendid service—can scarcely give a result big enough to compensate debilitated children for a trip twice daily across a city. Besides, since the cooperation of the home is one of the chief factors in this game, there is no question but that the room should be close enough at hand so that the mother can come in often. She should be expected to come in once a week to have a regular health meeting, where she is instructed, and where the whole program can go forward with the school and home working together. This means that there should be smaller centers, simpler, perhaps just a room or two in a regular building that will care for the children of that neighborhood. There should be one or two of these in every school building certainly until we have made the entire system insure health to the entire group.

We found upon examining and tabulating the results not only of the schools that we were familiar with in Chicago, but of schools throughout the country, that it was the general opinion that results in weight and other signs of physical improvement, in educational progress and in the general attitude of the child were quite as good in the simple little open-window rooms as they were in a special open-air school.

We have, then, these classes of children to deal with from the sociological viewpoint, and each community must meet its needs with an adequate program, which shall work at the same time toward keeping the well child well.

The Chairman: We are going to pass immediately to the next paper but before we do that, in order that you may have the points that Miss Murphy has so splendidly made, may I in a very imperfect way reiterate or sum up as I understand it, her message to us this morning?

In the first place, as to the undernourished child: Every social agency, the family welfare, the playground, the settlement, should look after its own children to see that they are normally able to participate in its program, and then to reach the great mass of children, we should put the responsibility upon the school to see that before it sets its children for-

ward in a five-hour day program those children are capable physically of undertaking that program.

Then, please do not, I beg of you, miss her second point, passing over the open-air room for a moment: That when it comes to the active tuberculous child, the child excluded from the school because it has tuberculosis, so pronounced on diagnosis, it is not the school that that child needs, for education is entirely subordinate to the recovery of that child; but it needs ministration in the home, through the physician and the nurse, or by institutional care in a sanatorium or preventorium. I hope that position that Miss Murphy took this morning is going to be further brought out.

But third, in regard to these open-air schools, and no one can speak on that with more authority than the Elizabeth McCormick Memorial Fund: We ought to work for their elimination, by the fact that every room is an open-air room; that we have ventilation, that we have a proper regime. But in the meantime, these rooms should be located within easy walking distance of the school population that frequents them.

Over and above everything else that Miss Murphy has told us is the linking up of the home, the carrying back of the responsibility into the home, getting the settlement, the family welfare, the playground, the school linked up with the parents, and putting the responsibility on them.

Now, without further delay, I will ask you to please remember those three points. If I have incorrectly summed them up Miss Murphy will correct me.

We are going to proceed at once to the next speaker. We have had the sociological point of view. We are going to have the medical point of view now, and we are very fortunate in having on our program a man who can speak on this topic with authority. I take pleasure in introducing to you a man known to some of you, not as well known to all of us as we will know him now—Dr. Herbert M. Rich, of Detroit.

A MEDICAL BASIS FOR A PROGRAM FOR PREVENTION AND TREATMENT OF TUBERCULOSIS IN CHILDHOOD

By Herbert M. Rich, M.D.

Detroit

In considering plans and methods for the prevention of tuberculosis in childhood, it is important to have in mind the various ways by which the infecting tubercle bacillus reaches the child. These are chiefly three:

1. First, through the air. Tubercle bacilli coughed into the air by a consumptive may be breathed in by another individual. Such organisms may find a lodging and begin to grow in one of three places, the adenoid region, the tonsils, or the inner surface of the bronchi. Continued growth in the tonsils spreads to neighboring glands chiefly in the neck, and we find the enlarged tuberculous glands of the neck, formerly called scrofula. This condition is technically known as *tuberculous cervical adenitis.*

Infection of the adenoid tissue may travel directly down the lymphatic chain into the chest, infecting the posterior bronchial glands.

Infection of the bronchi spreads to adjacent groups of the glands and thence along the blood vessels into the lungs.

2. Second, infection through the mouth. This is commonly through milk from tuberculous cows. The tubercle bacillus passes into the stomach and intestines, passes through the intestinal wall and lodges in the abdominal lymph-glands. From here it is carried by lymph-channels to various structures, especially to the bones and joints. From such a distribution arises Potts disease, tuberculosis of the spine, and the great number of deformities caused by tuberculous hips, knees, ankles, and other joints.

3. Third, infection by direct contact. Infants crawling on a dirty floor may come in contact with virulent tubercle bacilli. Some cut, wound or abrasion of the skin offers a point of entrance for the organism and tuberculosis of the skin follows with extension to nearby tissues.

A campaign of prevention, then, must take cognizance of these various methods by which the disease is spread.

To combat the air-borne infection, children must be kept absolutely separated from open cases of tuberculosis, and this includes not only the consumptive, but all those with discharging tuberculous sores. This is a very important and often difficult matter. For example, if a con-

sumptive father or mother lives in a house with children, safety demands that either the patient or the children be removed. Usually the easier way is to place the consumptive in a sanatorium and arrange to have the children cared for in the home. Such children should then be under careful observation for one or more years. The open-air school offers a suitable opportunity for observation of children of school age. Younger children should be taken regularly to the clinic or to a private physician for periodic examination.

The question becomes more acute when a consumptive woman gives birth to a child. There is a popular idea that such babies are always weakly. This is a mistake. In the great majority of cases such infants are as well and strong at birth as any others. So great is their susceptibility, however, that even a few days spent with the mother is enough to make certain the death of the child from this disease, usually within a few months. To save such a child it must be removed from its mother the day it is born and so long as she expectorates tubercle bacilli, it should never come near her. This sounds like cruelty, but the alternative is plain.

In Sweden there is an organized plan for sending the children from tuberculous families to selected country boarding-homes. Commonly these children remain as boarders throughout their whole childhood. The plan seems highly practical and greatly to be commended. It is carried out under the auspices of the National Tuberculosis Society by a so-called "Care of Children" Committee.

Children under the age of four, and especially the new-born, should not go to an institution except for a short time as an emergency measure, or during acute illness. The very high death-rate among young children in every foundling home is well known. They do not respond well to institutional care as a rule. They need a home. For this reason it is important to emphasize here the desirability of a plan of nursing homes for infants and the younger children taken from tuberculous families. For older children the preventorium fills a very distinct need. Here they may be placed under ideal hygienic surroundings and watchful care until they regain good nutrition and blooming health. A certain amount of school work may be done here.

The prevention of tuberculous infection by food is largely a question of milk supply. No community health problem is of more constant importance than this. Dairy herds must be frequently inspected and the tuberculin test freely used. Suitable laws must cover the various phases of this subject. Recent figures indicate that bone and gland tuberculosis in young children is very largely caused by the bovine bacillus, at least 75 to 80 per cent. (Mitchell). Here comes also the question of eating from dishes contaminated by tubercle bacilli. I recall one instance of a boy one year old who spent much time on his father's bed. The father had far advanced consumption and amused himself by changing his pipe from his own lips to the child's mouth. The sad sequel was that this

father and child died within twenty-four hours of each other and both were buried in the same grave.

The prevention of direct inoculation of the skin comes again to the question of the separation of children from open cases. It includes also such care of the sick as to insure absolute cleanliness of the patient and the surroundings. As a matter of fact, unless such care and cleanliness prevail, it is never safe for the well to be about those who are sick with any infectious disease.

There are two medical facts which every social worker in the tuberculosis field should recognize; namely, first, that infants are highly susceptible to this infection; second, that the mortality rate for tuberculosis in infants is 100 per cent.

It may seem difficult to hold this consistent with the fact that tuberculosis workers are told that a sanatorium is a safe place and that they need not fear catching tuberculosis. As a matter of fact, one's immunity to tuberculosis ordinarily increases with each succeeding year and adults have very little to fear from re-infection unless they are in very close contact with an expectorating patient. But it is very different with infants and young children. Their immunity is slowly established and easily broken down. It is important that this conception of immunity as gradually increasing in each individual should be understood. It may be stated that in childhood immunity is never complete.

When a child becomes infected with tuberculosis his vital tissues become at once the seat of a struggle between the forces of life and death. The natural defences of the body bury the invading bacilli deep in lymphatic glands and surround them with dense scar tissue. The ability to segregate such invading bacilli is a measure of the immunity of the individual. It should be understood that, when for any reason such immunity breaks down, the bacilli may again become free wanderers through the lymph spaces of the body, liable to cause serious disease at any time.

Although a child may seem very well and strong, an attack of acute disease, prolonged nutritional defect, or unhygienic surroundings may break down his resistance at any time and tuberculosis become active.

When a child recovers from measles or scarlet fever, he commonly obtains such immunity that he is free from that disease so long as he lives. When a child apparently recovers from tuberculosis, we now know that it is merely the beginning of "trench war-fare." The tubercle bacillus still lurks in secret, waiting a favorable moment to attack its victim again.

This leads us directly to the question of those conditions which are most likely break down the immunity of the child and pave the way for frank tuberculosis. The principal causes are:

1. Malnutrition. This is a very large subject which I shall not attempt to discuss here, except merely to say that the modern movement to meet this condition in the schools is of very great importance and hopefulness.

2. Acute disease, especially measles, influenza, pneumonia, whooping cough.

3. Diseased tonsils, teeth and adenoids.

4. Rickets.

5. General bodily ptosis. This is perhaps best known as bad "posture," it commonly covers numerous physiologic defects and is often associated both in children and adults with tuberculous disease.

This list connects the tuberculosis problem in children directly to the general health resources of a community. Where these things are neglected, tuberculosis will flourish along with rheumatism, valvular heart disease and other grave maladies. One of the essentials, therefore, in the campaign against tuberculosis in children is a general hospital equipped to care for children, and specialists in children's diseases.

For children actually ill with tuberculosis, the most important provision is a proper sanatorium. At this point I wish to insist that a proper sanatorium is a real hospital and that it is for the sick only. I am strongly opposed to the boarding house idea of sanatorium. It should be a hospital or nothing. Sick children should be sent to the sanatorium, children needing good care but who are not actually ill may be sent to the preventorium, or to the open air school. This may seem a simple point, but as a matter of fact, it is very important. The opposite is frequently done and has serious results affecting the health of the children in question. At this point especially, social workers will do well to avail themselves of the experience of the medical profession. The decision as to whether the child is ill and needs hospital care, or is not ill and needs good hygiene and observation only, should always be left to the physician.

The children's pavilion at the sanatorium, in order to meet the medical needs of these cases, should have, in addition to regular equipment, the following items:

1. Isolation rooms for care of contagious disease. This is very important.

2. School rooms for those able to attend.

3. Porches for sun treatment.

4. X-ray equipment for deep therapy treatment of glandular tuberculosis.

5. Special diet kitchens for preparing food.

CONCLUSIONS

The medical aspects of tuberculosis in children, then, call for the following measures for prevention and cure:

1. The removal of children from contact with open cases.

2. The placing of infants of tuberculous mothers in boarding homes.

3. The preventorium for older children with malnutrition in contact cases which cannot well be cared for otherwise.

4. The open-air school for older contact cases with passable home conditions.

5. Malnutrition classes in schools.

6. Medical school inspection in which causes of malnutrition are studied thoroughly.

7. These measures of course pre-suppose competent medical and nursing supervision. This includes tuberculosis dispensaries, chest clinics and visiting nurses.

8. The provision of constant inspection of milk supply with authority to exclude milk from tuberculous cows.

9. The sanatorium with a special building and equipment for children.

10. A children's hospital where co-existing disease of any character may be properly treated.

The Chairman: We have listened to two most valuable addresses this morning and we are to have brief discussion. While we may not have Mr. Deacon to speak to us as scheduled on the program, his organization will be represented by one who can ably discuss this subject for us. Dr. M. Alice Assersen, Secretary of the Children's Service of the New York Tuberculosis Association. Dr. Assersen.

DISCUSSION ON PAPERS BY MISS MURPHY AND DR. RICH

Dr. M. Alice Assersen, New York: I wish to tell Miss Murphy how thoroughly we agree with her in what she has said with regard to the care of the malnourished child, and particularly the care of the malnourished child in the schools; and I wish to emphasize the fact, that in caring for these children it is so very necessary and important for us to have the co-operation of all the school factors—the nutrition department, the department of physical training, and the interest of the teacher herself. I believe that in our open air classes—we have about 117 in New York and many more open-window classes—we have obtained the co-operation of many of the teachers.

Interest the teacher in health matters so that she may impart to the children the importance of keeping well, and initiate ways of stimulating their interest in the subject, and of bringing into the schoolroom the parents, then we shall have made of the schools a most splendid instrument for the prevention of tuberculosis.

It is quite natural I think, for all of us who are members of this splendid organization, to think with pride of the work of the past, and now we are looking forward with a great deal of eagerness toward future

accomplishments, for a great deal will depend upon the completeness of our program and the effectiveness with which we carry it out.

Through the medium of the schools we have a very large number of children brought together every day, for whom we have already organized health work, and for whom we are planning much more. We have reached them, and we are still reaching them through health education, health clubs, and the Modern Health Crusade. For the smaller groups, including those suffering from malnutrition and those exposed to tuberculosis in the homes, and those with arrested tuberculosis, we have nutrition and open-air classes. We also have preventoria and day camps for this same school age group.

But when we consider the group of which Dr. Rich has spoken—the babies exposed to tuberculosis—we have done practically nothing. These babies are in constant physical contact with the mother; they are infected and re-infected with massive doses of tuberculous poison. We know that their death rate from tuberculosis is high, and yet this group is seldom included in our plans for the care of children exposed to tuberculosis. At the infantorium in connection with the Preventorium at Farmingdale, N. J., beds have been provided for babies of tuberculous mothers who are taken, if possible, at birth, before infection has occurred, and many of these children have been saved.

The French, and as Dr. Rich has just told us, the Swedes, have adopted a system of boarding out babies of tuberculous parents from the moment of birth, and I believe that a very important part of our work in the future will be the development of a plan by which we may do the same. I quite agree with Dr. Rich, that the institution is not a good place for a baby, unless it is particularly well equipped with attendants, so that each baby may receive individual care and affection, to compensate, in a measure, for the loss of the mother.

We have another group of children for whom we have done very little, and that is the pre-school age group. We have few nutrition classes for them. We have preventoria for children but I think that all of the doctors, nurses and social workers who are here will agree with me that it is a most difficult problem to place the child of pre-school age in these preventoria because they need more care than older children; consequently a larger expense is incurred in providing for them. The doors are practically closed to the children of pre-school age in the preventoria. Summer vacations and outings are also provided for our school age group, but the children of pre-school age are seldom included.

We have another group for whom we need the development of more health supervision; these are the boys and girls of the adolescent period who are entering into industry. These girls and boys are examined when they apply for their working papers, but I believe that a very small proportion of them are followed up and brought back for re-examination after they have been at work for a period of time. Much health work could be done through the continuation schools which these children are obliged to attend.

These are just a few of the problems of community care of the malnourished and exposed children. Our methods of meeting these problems and of strengthening the weak places which already exist in our health program, will largely determine the rate of the tuberculosis reduction of the next ten years.

Dr. L. B. McBrayer, Sanatorium, N. C.: I wanted to ask one question that I think we ought to consider very seriously. I was greatly delighted to hear the remarks in regard to making every schoolroom an open-air schoolroom. My opinion is that any properly constructed schoolroom has the means of sufficient ventilation, and every questionnaire that has come to me (and I assure you there have been many) in regard to open-air schools has been replied to for the last five years in this wise:

"We have no need of open-air schoolrooms in North Carolina. What we need is to get the windows open that we already have."

The particular question I want to ask follows this out. I noticed Miss Murphy stressed considerably the hot school lunch, and I want to ask Miss Murphy or Dr. Rich, or both, particularly Miss Murphy, to tell us why a hot lunch is better than a cold lunch? How much more nutrition is in the same amount of food, hot or cold?

Miss G. I. Pelton, Denver: I want to confess my ignorance and ask if postural defects are usually secondary or, if they are always due to some defect, to tuberculosis, or to malnutrition?

The Chairman: Your question is: Are postural defects due to malnutrition or tuberculosis?

Miss Pelton: Or possibly other defects.

Miss Virginia M. Chetwood, Hackensack, N. J.: I would like to ask what the Doctor and Miss Murphy think the difference in value between the artificially ventilated school building and the building ventilated with God's fresh air.

Dr. Charles R. Grandy, Norfolk, Va.: I want to bring out one or two suggestions in connection with the most instructive papers which have just been presented. As indicated in Miss Murphy's plan, the principal thing is to get your teachers interested. Now, how are the teachers going to get the children that you want to have examined? By putting down four things: First, the child that is 10 per cent. underweight; second, the slow child, that is, the child that is sleepy and stupid; third, the child from a sickly household; fourth, the child that has frequent colds or coughs. If any child has two of those four things, that child should be examined further by the school doctor or nurse, or sent to the regular tuberculosis clinic for examination.

If you find a mark in the spinal side, if you find dullness over one or both upper lobes, if you find the increased expiration over a larger area than you usually find in your purer breathing, if you find constant râles

on several examinations not only in the upper lobe but somewhere else, then those children should be kept in your clinic and watched.

Another question is what children should be given the extra nourishment in the schools? Again everything should start, if possible, with the teachers and the principals, and not with the workers. If they find children and send them to you, what do you have to consider? First, are the people able to pay? If they are able to pay the society should not pay for them. Secondly, are the children underweight? Then we come to some of the other things that bring the children to the school. The tuberculosis association should be willing to help out with the food and the nurses from the tuberculosis society should investigate the family conditions.

How should we give the food, say the milk and crackers, which do very well to add to the children's nourishment in schools? The practical way is through a card. Let all the children get the same card; the children who can afford to pay the five cents for it pay that amount and get the ticket from the principal of the school. But the principal also furnishes cards or tickets to the children who can't afford to pay, and the tuberculosis society pays for their food. In that way, the children are not made to feel that they are paupers.

Dr. Mary Moore Hoyt, Rochester: May I ask Dr. Rich if the children whom he showed us, who had ptosis and who were taking the exercises, were underweight; and if there was any other treatment beside the exercise used in their cure?

Miss Eva G. Baker, Erie, Pa.: Might I ask that all of you here who are so interested in what we have heard this morning, make an effort to get some of this knowledge that Dr. Rich and Miss Murphy have given us before the teachers in our various communities, our teachers' institutes, and the county teachers' institutes? If they are having health education in their normal courses in the summer, help them to get some of these pictures and let them see that we are ready to help them on with this matter.

The Chairman: I would like to ask Dr. Rich two questions which he may not have time to answer but which to some of us, I believe, are very important: The difference between the sanatorium treatment and the preventorium treatment; and also, if he can tell us who are laymen, what constitutes the findings which declares a child in the communicable active stage of tuberculosis.

Miss Murphy, will you answer the questions that were asked you? Then we will call on Dr. Rich to answer his question.

Miss Murphy: Just recently we have been conducting a survey of rural school conditions, with reference especially to health and health education, and among the factors that were repeatedly mentioned as very important in building up the nutrition of the children was the hot lunch.

The people answering the questions were for the most part nurses, teachers and home economics workers, who are out in the field as extension workers from the various colleges, and agricultural departments. With no exception, they spoke of the hot lunch as a vital factor in building up the nutrition of these children.

One reason is that it is an educational factor in giving the children the ideas as to what they should eat in the middle of the day. They supplement usually the hot dish at the school with some simple sandwiches and fruit from home. The general opinion was that the hot lunch rested the child more than the cold food, that the work done in the afternoon was very much better; and that tests made by weighing children before the hot lunch was put into the school and after showed that with no other factor in the school itself the improvement was marked. The percentage of gain was very great indeed. All other factors apparently being equal, the hot lunch was thought to be responsible for the gains.

In regard to postural defects, we have noted those in connection with our undernourished children and have seen that the posture improves as the nutrition of the child improves.

Artificial ventilation was mentioned. Many of you are familiar with the report of Dr. Josephine Baker, in which she made a study of three types of rooms; the regular closed room, the open-window room and the open-air room. Now, in making that study, she had great difficulty to find the artificially ventilated room in its supposedly normal condition when the ventilating system was at work. It was so often on a vacation that she found it very difficult to make the test.

I think that the gentleman from North Carolina made the point that if the windows were built properly and there is air outside of the windows, by opening the windows you would have an open-window room, and the tests that have been made—although they are not many—prove that that is right. That is up to you people. Really you ought to go home and make those tests and have demonstrations to show that there is something in the argument in favor of fresh air in a school room—it shouldn't be left to just two or three communities—and when you have your proof present it to the school board in a request for air for all school children.

I know a town of about 7,000 where their chief pride in the new building that they have just erected is that the artificial ventilating system cost so much money. They are proud of that building because of that. Whether it will operate in favor of greater health to the children does not seem to be considered.

The Chairman: Dr. Rich, will you answer the questions that have been asked?

Dr. Rich: In the first place, hot foods and cold foods have exactly the same nutrition value, so far as their chemistry is concerned; but cooking food takes it a little farther on the road to digestion. That is why we cook food; at least, that is one reason why we cook food. Food

that is cooked is more easily digested—perhaps I had better qualify that a little bit and say "properly cooked food." And I suppose that is the reason why the hot lunches are better than the cold ones.

Posture defects is a very large question, which I can't go into now. I didn't call it posture defects; I called it congenital ptosis, and I simply said that it would be known to social workers as posture defects, because that is one phrase that is known on account of the propaganda of the American Posture League. But the condition doesn't follow malnutrition or tuberculosis. Some one asked if it followed tuberculosis. It does not. It causes tuberculosis; it includes a great many physiologic defects, largely muscular. There are poor back muscles. I showed you the pictures so you could see that they were poor muscles, in the back, in the legs, in the abdomen, the flat chest, the round shoulders. The shoulders have to be round; if they stood up straight they would fall down; in order to keep the center of gravity over their ankles, those children must have round shoulders. This idea of whipping the child because it has round shoulders is terrible. They can't help it; if they didn't have round shoulders they wouldn't be able to stand up. If you are going to stand erect you must keep the center of gravity over your ankles, and if you have a hollow back you have got to have round shoulders.

The cure for that sort of thing is partly forcing nutrition, which Miss Murphy has mentioned; but the essential cure for the thing is the development of the muscles and chiefly the muscles of the back. As the back drops in, the stomach drops down, the intestines drop down, the heart drops down, and you will very often get the whole intestinal canal below the top of the hipbones, instead of up here where it belongs. The result is bad digestion, poor resistance to disease of all kinds, more or less constant annoyance from pain and discomfort, and continual weakness, easy fatigue, and with women later in life, general invalidism.

It is a very important subject, and is simply one of the things which predisposes to tuberculosis, and so I mentioned it, because the posture class for children is one of the very important methods of prevention.

The Chairman: Will you please answer my question now?

Dr. Rich: In regard to the difference between sanatorium and preventorium: the preventorium is for the contact case who is not sick; the sanatorium is for the sick child, and no other.

The Chairman: And when is a child sick from tuberculosis?

Dr. Rich: That, we leave to the doctors. Don't you interfere; we have trouble enough ourselves.

The Chairman: That seems to be the point, doctor. The doctors sometimes seem to disagree on the question of when you can pronounce a child actually sick. Now, we have an ordinance in Washington that when a child has tuberculosis in an active, communicable form, he must

be discharged from the regular grades, although he may still go to a special school. Upon what is that judgment ordinarily based by the physician? What are the signs?

Dr. Rich: There are no signs about it. If he has a positive sputum he is a communicable case.

The Chairman: With nothing else?

Dr. Rich: If he has a discharging sore or positive sputum that is a communicable case.

The Chairman: The doctor has told about the communicable case; will he tell us about the active case of tuberculosis now?

Dr. Rich: That is a medical question which it is very difficult to answer and I decline to enter a discussion on that. It is very simple to answer what a communicable disease is. If you have positive sputum or discharging sore, it is a communicable case, and the child should not go to school.

The Chairman: You have used the term sick child for the sanatorium; now can you give us the signs of a sick child, which make him eligible for the sanatorium—may I put the question in that way?

Dr. Rich: The child who is a contact case, for instance, who develops symptoms of illness might well go to the sanatorium, unless it should be some very evident disease such as scarlet fever or measles, or some other contagious disease; it depends entirely on what he has. If he has an obscure illness and he comes for a case of tuberculosis, why then he is brought to the sanatorium. It is not the well children who are brought there.

The Chairman: The reason I am asking these questions is because I think we social workers want to get light. I think we all agree the doctors must decide this point.

Dr. Rich: I think you want me to tell how we decide.

The Chairman: The physical signs by which a child ought to be put in a sanatorium.

Dr. Rich: You cannot put it down on paper in a few minutes. The thing is too complicated and too difficult; anyone who tries to will merely mislead you. Don't think that anybody can give you a rule of thumb by which it can be told. It can't be told that way. I put those first pictures on the screen purposely to show you things that have been called tuberculosis that are not tuberculosis at all.

The Chairman: I think we can sum up the discussion this morning, certainly on the preventive side. We shan't go away from here without feeling that any child that has any of these predisposing symp-

toms—the underweight, the undernourishment, or any of these postural defects, or any thing else that has been brought out this morning—should be followed up with the greatest care. And I am sure, on behalf of this audience, I may express gratitude to Miss Murphy and to Dr. Rich; and we may thank Dr. Rich for his frankness, for his position of agnosticism—if it is that, so that we social workers may be more charitable in our judgments when the doctors are not prepared to advise us positively as to the condition of the particular child that is sent to a clinic.

If there are no further questions, adjournment is in order.

NURSING SECTION

Chairman

MISS ANNA M. DRAKE, R.N.

DES MOINES

Secretary

MISS BERNICE W. BILLINGS, R.N.

BOSTON

THE FUNCTION OF THE PHYSICIAN AT TUBERCULOSIS CLINICS

By Stanley L. Wang, M.D.

New York

The function of the physician at tuberculosis clinics is to examine and diagnose patients, and to advise them regarding their condition. He should have knowledge of the various institutions where patients are cared for; how to gain entrance into them, and how best to utilize local facilities in the home treatment of tuberculosis. He is responsible for making an easily understood record of his findings and recommendations in order that patients may be intelligently cared for.

At occasional clinics, or, as they are better described, at clinics where there is no continuous dispensary service, the function of the physician is somewhat limited. Patients are seen only once; a single examination is made, and he must as a rule advise them immediately, basing his advice on the information obtained at the single visit.

At permanent clinics, or, rather at clinics in localities which are conducted at regular intervals, he can render a service of greater scope. A more thorough study can be made of patients by requiring them to return for subsequent visits. Those who cannot come for examination on a certain clinic day can be seen later at the mutual convenience of the patient and the physician. They can be studied before they are admitted into the sanatorium and followed up after their discharge from the sanatorium. "Contacts" can be regularly examined, and patients and others can be better informed regarding the prophylaxis and treatment of tuberculosis by frequent repetition of the essentials. Then too, the physician at permanent clinics usually has a more adequate knowledge of the hygenic and social circumstances of the patients' working and home life, and can thus better advise them.

The chief function of the clinic physician, and one that is sometimes neglected or obscured by the interest in arriving at a diagnosis, is that of advising the patient. From the patient's standpoint this is of the greatest importance. The patient is usually indifferent to the scientific aspects of his trouble, or at least considerably less interested in this phase of his trouble than in advice leading to his cure. One of the outstanding criticisms of our clinic work is that we do not give our patients satisfactory advice. They complain that they come to clinics, are examined, and return home having received no benefit whatever from their visit.

Primarily, the medical examiner is responsible for telling the patients whether or not they have tuberculosis. Some people seem to think that

individuals who are rather sensitive regarding their physical condition should have the fact that they have tuberculosis concealed from them. It has been my experience that it is more often harmful than beneficial to keep the patients from knowing what their trouble is. It is true that they are often shocked when they learn that they have the disease, but the zeal with which the patients endeavor to benefit themselves by treatment after they have recovered from the shock more than over-balances any temporary harm that has been done to them. I believe that it is the physician's duty in practically all cases to explain tactfully to the patients that they have or have not tuberculosis.

When a diagnosis of tuberculosis has been made, it is not sufficient to tell the patients they are to rest out in the open air or to go to a sanatorium.

A clear and easily understood regimen should be laid out for those who expect to take the treatment at home. They should be advised regarding how to take care of their cough and expectoration; how to keep a temperature record; the use of separate dishes; their clothing; the desirability of sleeping on a porch and how to construct one, and the advisability of procuring a cure-chair. It is a good plan to instruct the patient who is up all or part of the time to rest, according to the needs of the case, by the clock. In other words, a definite time, such as from ten to twelve in the morning and from three to five in the afternoon, should be assigned to sitting out in the cure-chair, and it should be impressed upon them that it is very important to carry this out. The hours of retiring and arising, the meals and what should be eaten, the need for regular re-examination, etc., should also be clearly explained by the clinic physician.

Where patients are advised to go to a sanatorium, the examining physician ought to point out the greater likelihood of obtaining a cure at a sanatorium and the value of sanatorium training, and then endeavor to persuade the patient to consent to enter the proper institution. He should explain to him the advantages and disadvantages of the sanatorium, mentioning particularly lonesomeness and homesickness. He should name the sanatorium and discuss together with the nurse and patient how arrangements are to be made for the patient being admitted there. Usually they want to discuss with the doctor the question of what sanatorium they are to go to, and he should have knowledge of the various institutions, and how to get into them. It is well to explain whether the hospital is a free one, for they need to know whether they will be required to pay for their care, and they are often reticent about asking about it. The transportation to the hospital, the kind of clothes they will need, how often they will be permitted to return home, are also matters of interest to the average patient.

Patients often come to clinics who might be benefited by treatment with artificial pneumothorax, thoracoplasty, tuberculin, heliotherapy, quartz lights, etc. Some come to inquire as to whether the various procedures might be applicable to their own trouble. The clinic physician cannot, of course, be expected to be experienced and familiar with all the special

lines of treatment but he should have some general knowledge of them and be able to tell patients where they can obtain such information.

Also patients often come to inquire about another climate and if change might be beneficial to them. Probably this question is asked more frequently than any other. The patient's financial status usually answers the question.

Most people when they learn that they have tuberculosis are eager for knowledge of the disease. They read the pamphlets that are handed to them at clinics, and they appreciate any other reading along those lines. Every dispensary or clinic service can advantageously utilize a little circulating library consisting of several copies of Dr. Trudeau's "Autobiography," Dr. Brown's "Rules For Recovery From Tuberculosis," current issues of *"The Journal of Outdoor Life,"* etc. Lending them out at clinics with a suggestion from the physician and nurse about the advisability of reading them is well worth the effort.

The medical work at both permanent and occasional clinics has not been as scientific and as thorough as all concerned would like to have it. Some criticism of the clinics has resulted, and this has probably lessened the value of the service.

Nurses who are conducting clinics can help a great deal to aid clinic physicians in bringing the work to a more scientific basis. First, by endeavoring to have a sufficient number of patients, and no more, than the examiner can examine. About twenty minutes per patient is a fair estimate of the capacity of the examining physician. In other words, a physician can take care of about three or four patients an hour, and the attendance should be limited if possible to that number. Having patients referred by local physicians is the ideal method of arranging a clinic, for in that way the number can be regulated and the most suitable can be obtained.

The next and most important part of the pre-clinic work from the standpoint of the physician is the carrying out in advance of a few procedures that will help greatly in arriving at a diagnosis and in giving the best advice. Three consecutive daily sputum examinations and three consecutive daily temperature observations should be made of the patients before they come for examination. Where x-ray facilities are available, and where it is feasible, an x-ray examination helps the examiner a great deal. The x-ray examinations are usually difficult to obtain because of the expense.

Some dispensaries have installed fluoroscopes for use in making examinations. Others have made arrangements whereby x-ray pictures are taken at laboratories located near the clinic. In New York State the State Department of Health has a portable x-ray apparatus which is used at occasional clinics.

While it may, in some instances, be difficult to obtain x-ray examinations, the sputum examinations and the temperature records can, however, be made of practically all patients in advance of the clinic with very little trouble.

It is the usual custom for the nurses to make a record of the patient's history before he is sent in to the medical examiner during the clinics. The physician is interested in knowing whether tuberculosis, or disease that is suspicious of having been tuberculosis, has occurred in the immediate family or the patient's associates. It is also important to find out and record in the history whether the patient has had any previous symptoms or illnesses that are indicative of tuberculosis, such as spitting of blood, pleurisy, and so forth. Very few cases of tuberculosis develop acutely, and a careful history will often reveal that there has been a previous period of weeks or months of more or less continuous coughing, of feeling run down, of being under-weight, anaemic and so forth. In listing the patient's symptoms interest should be centered on finding out whether the patient has symptoms of tuberculosis. The cardinal symptoms should be individually discussed and recorded on the clinical record. The history is of the most importance in making a diagnosis of tuberculosis and in subsequently advising the patient regarding the care, and the cooperation of the clinic nurse is needed by the examining physician to obtain as complete and as valuable a history as possible.

After the patient is examined a report of the examination and the advice given should be sent to the patient's physician. If the family physician desires, no advice need be given to the patient, but he may be referred to the family physician for the results of the clinic examination. The results of x-ray examinations, sputum examinations and of the temperature observations should be sent to the family physician. Local practitioners as a rule greatly appreciate information about the findings. Patients with disease other than tuberculosis are advised to consult their private physician.

The clinic physician proffers his services to the local medical profession as a consultant. The extent to which his services are availed of is dependent on his standing with them and how popular clinics are in that locality. The consultant phase of clinics is increasing and where the idea was unknown a short time ago it is now developing into an important part of the work.

The medical profession in some localities criticized the earlier clinics and in most instances the criticism was a justifiable one. Dispensary services were organized and established without the purpose being made known to the physicians as it should have been. This was especially true of occasional clinics. The physicians were often informed that a clinic would be conducted in their locality on a certain date and they were invited to send their patients there. No other introduction or explanation of the purpose of the clinic was given and sometimes not even that much and the only knowledge that they had was the notices and announcements in the newspapers. Naturally, they resented this procedure. The idea of an organization bringing an outside physician into a locality and publicly announcing that he would make special examinations of the chest, without cost, for all who desired it, was irritating to the local medical profession as it would have been to the

members of any other profession such as law, dentistry, etc., if a similar proceeding had taken place in their line of work.

Undoubtedly the best method of establishing a dispensary service, either occasional or permanent, is first to take it up with the local medical society and after having thrashed out its aims and purposes, to develop it with their cooperation, making plain that the clinics will be held with the physicians.

To what extent patients may be visited in their homes by dispensary physicians has not yet been determined. In most dispensaries the physicians do no home visiting except in rare instances, and then to indigent patients only. Also the dispensary nurse does not as a rule confer with the dispensary physician regarding patients she is visiting in their homes who are not dispensary cases. There is a great opportunity to help many of this group of home patients if the nurse and physician co-operate to extend the dispensary service to them. The dispensary physician and nurse ought to confer regularly about them, particularly concerning the sanitary conditions of the home, sleeping porches, cure-chairs, instructions regarding treatment and hygiene, the examination of "contacts," the obtaining of additional nursing service if needed, and the patients' social and financial circumstances.

The development of the occasional clinic service during the past few years has been the means of revivifying, in no small manner, interest in many permanent dispensaries, which the comparatively recent sanatorium building program had over-shadowed and detracted from. Now that the capital expenditures for sanatoria have been made, for the most part, in many communities and it has been ascertained to what extent these will probably be utilized, it is becoming evident that the majority of tuberculosis patients will spend a large part of their time in their homes where only the dispensary service can reach them. Thus far, the extra institutional care of tuberculosis has not received as much attention as the sanatorium care has received. However, it is quite likely the near future will see a great development in the dispensary-home care of the disease. The value of the dispensary for educational work, as an information bureau, for the reporting of tuberculosis and as a center for the supervision of home patients, has been proved and there is a great need for extending this service to the many patients who must, for various reasons, spend all or a large part of their time in their homes.

The Chairman: Some of these points that have been brought out by Dr. Wang have given me just the information I wanted, and I am sure the rest of you have felt the same way. I think that we, as nurses, are glad to hear that a great responsibility rests with the physician to give to the patient this careful instruction and diagnosis. We may give the instructions as nurses, but instruction on such items in the care of the disease as rest, diet, the care of sputum containers, and so on, means much more to the patient if it comes from the physician.

We want another word on the function of the physician in the general diagnostic clinic. Dr. Armstrong has done a very extensive piece of work, largely through the general diagnostic clinics, and we will be glad to hear what he has to say to us.

DISCUSSION ON PAPER BY DR. WANG

Dr. Donald B. Armstrong, Framingham: I have been looking to see if Dr. Bartlett, who has been the consultant in Framingham for the last five years is in the audience. I know that he is here somewhere, but I don't happen to be able to spot him at this minute. He could tell you much more with reference to the service of which the Chairman speaks.

Dr. Wang has covered the situation very adequately, and I doubt if it is worth while to enlarge upon the points that he has so well presented, except perhaps, to re-emphasize the value of the consultation service described.

We have found that of extreme importance in Framingham, particularly from the point of view of the detection of early tuberculosis, and the persuasion of cases to submit to proper and thorough treatment.

It is our experience that the tuberculosis consulting physician whose services are offered to the practicing physician in a community, partially as an adjunct to clinic or dispensary service, performs a number of valuable functions. I think he might be referred to as a sort of link—a three-fold link so to speak—coupling up, in the first place, the patient and the doctor, and thereby facilitating in a great number of cases, early diagnosis. In the second place, by persuasion and advice at least, if not by actual clinical therapeutic service, he connects up the patient with treatment by advocating the type of treatment needed in that particular instance, by urging it both upon the doctor and the patient. And in the third place, the consultant, having at his disposal the so-called instruments of precision in diagnosis and treatment, is able to make a third connection, namely, between the doctor and scientific standards—higher standards of practice with reference to diagnosis and treatment.

That has been brought out in our Framingham experience. We have observed there, over a period of five years, a very substantial increase in the number of active tuberculosis cases reported to the Department of Health—jumping from 13 as an average for the preceding ten years, to an average of about 40 for the last five years. We also had a corresponding increase in the percentage of cases sent away for institutional, sanatorium or hospital care, this percentage increasing from about 15 to 40 per cent. in five years. And, perhaps most important has been the increase in the percentage of cases discovered in the early stages.

During the first year of the demonstration, of all new cases discovered, about 55 per cent. were in the early stages, whereas in the last two years,

somewhere in the neighborhood of 80 to 85 per cent. have been thus reported.

The one outstanding thing working for these accomplishments is the consultation service, operated as a part of the health station or dispensary machinery—the examining service being offered to the physicians on either a free or pay basis. The examiner examines patients at the patient's home, at the doctor's office, or in his own office.

Of course, the question arises that while that has been an extremely valuable contribution to the work in Framingham, it may not be practicable for other communities. There is, however, a certain financial return which is part of the service; a certain percentage of the consultations are paid for, while contributions may also be anticipated from social and civic bodies. A substantial underwriting of a portion of the service also is to be expected from industrial groups, for he may serve as a consultant not only to private physicians, but also to factory clinic physicians. I believe that this service has been demonstrated to be an indispensible part of the community's machinery for the detection, control and prevention of tuberculosis, and it will ultimately become a charge upon the community as a part of its routine health and tuberculosis machinery.

Dr. S. Adolphus Knopf, New York City: I listened with unusual interest to the paper just read as well as to the remarks of the preceding speaker. Having had the honor, as consultant in the New York State Department of Health, of conducting a few of the traveling clinics, I feel that I can speak from personal experience concerning them. It would seem to me that more attention should be paid to the selection of examining and waiting rooms for these traveling clinics. The examining rooms should be light, well ventilated and well heated in winter. They should be cheerful and have furniture arranged so that doctor and nurse can work with comfort and so that the patients can be made comfortable.

The waiting room, of course, should also be light and airy, with comfortable seats. If at all possible, patients should be examined by appointment, so that there are not too many crowded in the reception room. To be obliged to sit for hours in a badly ventilated and cheerless hall or room in an uncomfortable chair is discouraging enough for a well person. How much more so must it be to a tuberculous invalid into whom it has been dinned that fresh air and light are essential for his cure.

The nurse at such a traveling clinic can be of the greatest help to the consultant as well as to the physician who has sent the patient, and to the people of the community where she is trying to find suspected cases. By carefully preparing a history she can help the consultant; by sending a correct report of the latter's findings, she can help the patient's physician. The people of the community she can help by saying to them and to the suspected patient, "If the examining doctor finds any one among you to be tuberculous, he will get the best possible advice,

and if any one is examined and is not found to be tuberculous, he will find that the examination has not hurt him." The first question which will be asked by the tuberculous individual is, "Must I go away to get well?" Let the immediate reply be, "The all important thing in the treatment of tuberculosis is not so much where you live as how you live." The more cheerful the tuberculosis nurse, the greater will be her field of usefulness and her ability to serve the tuberculosis cause.

Let me finally say a word as to the conduct of the consultant. He should strive to gain the confidence and good will of all the physicians residing in the community he visits. He can easily gain their confidence by tact and discretion. He should avoid saying anything which might be interpreted as finding fault with the physician for having failed to make a diagnosis. He should come as a teacher and not as a critic. The more tactful he is in his capacity as consultant, the greater will be his usefulness.

As a whole, these traveling clinics rightly conducted, supervised, and supplied with the necessary equipment for doing good work, are bound to take important part in the reduction of the morbidity and mortality of tuberculosis.

The Chairman: I am glad to find, after listening to these talks, that perhaps we are on the right track. When we first began our occasional clinics, the people in the community would say, "Nobody will attend them, if you say 'tuberculosis clinic.'" As you know, Iowa is a prosperous rural state and each community feels that it has no problem. And so to pacify the community, we had child welfare clinics as a sort of drawing card. We thought the people would come and bring their children and then slip into the tuberculosis clinic and submit to examination. But we were mobbed. We have finally done away with the child welfare clinics, and still we are mobbed. We simply advertise a tuberculosis clinic, and we can't possibly take care of the people.

We find that it is a great help if the cases are carefully selected so that the examiner, having only one day for the clinic, will not have to examine those who want to be examined just because their great grandmothers had tuberculosis or because they had the flu, when the history shows no symptoms whatever. We find it a little difficult for the ordinary public health nurse to make this selection, and so we ask the community in each case, to let one of our staff nurses come and go over the cases carefully, eliminating some and referring them to the family physician for first diagnosis. In that way we do not fill our clinic with poor material. We try to select those who have evident history or symptoms of tuberculosis.

We will now take up the subject of the Function of the Nurse—what may the nurse particularly do, what special service may she render in the permanent clinic? Miss Lucinda N. Stringer of New York will present that phase of the question to us.

THE FUNCTION OF THE NURSE IN THE PERMANENT TUBERCULOSIS CLINIC

By Lucinda N. Stringer, R.N.

New York City

The effective control and ultimate eradication of tuberculosis depend mainly upon two conditions, medically speaking, the segregation of the advanced cases and the early recognition and treatment of incipient ones.

In the permanent tuberculosis clinic we have a machinery capable of realizing the latter condition and developing it to the limit of its possibilities.

The function of a permanent tuberculosis clinic is:

1. To diagnose doubtful cases.
2. To administer medical treatment.
3. To supervise patients in their homes.
4. To serve as a clearing house for hospitals and sanatoria.
5. To educate patients and their families.

The efficient fulfillment of these functions depends upon:

1. An adequate clinic staff.
2. A thorough knowledge of the district covered.
3. An effectual follow-up system.
4. Development of the social phases of clinic work.
5. Close cooperation with other tuberculosis agencies.
6. The keeping of accurate records.

It is obvious that the nurse plays a very definite part in helping the patient back into a state of health, and that team work between the physician and nurse is most important and cannot fail to be of great direct benefit to the patient.

When there is only one nurse attached to a clinic the planning and carrying out of her work will be an individual personal matter. In the larger clinics where several nurses are employed, it is essential that a supervising nurse be charged with the responsibility of planning and overseeing the work of the individual nurses. There should be one nurse for every 100 patients, including dispensary care as well as home supervision and social work.

THE NURSE'S DUTIES

The nurse's duty should consist of arranging the clinic for the day's work, admitting and interviewing applicants, distributing paper handkerchiefs and printed instructions, taking social history before the patient sees the doctor so that he may know something of the possible cause of the disease, giving admission cards, giving specimen bottles (urine and sputum) with instructions for use, weighing patients and taking temperatures and preparing the patient for examination. It is also her duty to coordinate the special clinics (such as nose and throat, dental, etc.) with a view to restoring the patient to complete physical efficiency.

FOLLOW-UP WORK

The nurse is the link between the clinic and the home. Before or after clinic hours she writes up the result of her home visits on the history; the rest of the day she spends "following-up."

By far the greater part of her work will be preventive and educational. She will instruct the patient and his family in regard to diet, personal and home hygiene, and assist in the formation of a plan for the patient's admission to sanatorium or hospital. Part of her duties consist in teaching the family of the nature and necessity of fumigation after death or removal of patient. She should teach the necessity of a thorough housecleaning afterwards and the destruction of infected material.

The nurse is in a position to instill in the patient trust and confidence in the doctor and in the therapeutic means he is employing. She interprets to the patient the various procedures the doctor wishes carried out, and can devise ways and means which will assist the patient in carrying out these procedures. She can impress the patient with the importance of faithfulness and persistence in following the doctor's directions.

There has, of late years, been a great awakening of the civic responsibility of disease and its social causes. This has been universally acknowledged in tuberculosis, where the treatment and care depends, not only on the attack of the tubercle bacilli but also on the underlying causes,—unsanitary homes and workshops, long hours of work, low wages and improper feeding. Modern medicine has come to deal from the preventive standpoint and the social causes of the disease. We are tired of the policy which spends from three to four dollars a day on caring for a patient in the hospital or sanatorium and leaves untouched the home condition which will, with reasonable certainty, compel the patient or his family to return for the same expensive process. Perhaps no one disease offers a more fertile field for social work than tuberculosis.

Of the essentials for the treatment of tuberculosis as laid down in our text books, not one of them can be made to work without a vast amount of labor over details and personal adjustments. Food, rest, fresh air and sunshine are commodities which cannot be bought like drugs. The physician may order them but they do not get to the patient unless per-

sonally conducted all the way, and it is the function of the nurse to make effective these three essentials in the treatment of tuberculosis.

To remedy and change deterring conditions in the homes and the industrial environment is part of the work of the nurse, who also aims to instruct and direct the patient to realize his share of the responsibility. She should also interpret to the cooperating agencies in the community who are struggling to rehabilitate the family, the physical situation and its significance. She should keep the physician acquainted with her plans and efforts for the patient. While her principal work is with the patient, it does not stop with the patient. She insists on treating the family as a unit, looking into the social and physical needs of each member of the family. A visit to the home often reveals the fact that other members are suffering likewise. Further investigation reveals unsanitary homes, money difficulties, ignorance of personal hygiene, all of which can often be soon adjusted and the family put in a normal condition.

In cities it is particularly important that she understand what is called the "immigration problem." She cannot hope to master the languages of these aliens, but it is possible for her to know something of their racial characteristics, their customs, their traditions, their habits of mind, and to approach them with a sympathetic understanding of their difficulties in this country.

The nurse should accumulate facts bearing on the causation of disease as it relates to hygiene, ventilation, correction of food, quantity, etc., crowding, occupation of the individual and allied conditions, and in what manner it supplements and aids in the intelligent carrying out of the treatment prescribed by the physician.

The supervision of the sanatorium or hospital should not end when the patient is discharged. The ex-sanatorium patient should be given sufficient supervision by the nurse to help him establish, in his old surroundings, his new habits and mode of life. He makes a successful stand for his newly acquired habits for a while, but without the constant encouragement which the frequent visits from the nurse give, he sooner or later succumbs to the habits and influence of a lifetime.

At present our patients return from the sanatorium, where they have been watched and supervised constantly and visited by a nurse or a doctor once a day at least, to the same surroundings and influences which they left and which were more or less responsible for their breakdown, to be visited by a nurse only once a month or once in six weeks. Too long have the efforts and expenditures of time and skill of both physician and nurse been nullified by patients returning to the same environmental conditions which were largely responsible for their illness.

The importance of follow-up work cannot be overestimated; efficiently conducted, it is a saving of effort and money. It saves from relapses and assists in readjusting to self-support those unable to resume customary occupations. Tuberculosis is not merely a human disease, it is a social disorder, and the real problem is not alone the patient but the

family and the conditions under which they live, and the logical way to combat it is to attack the fundamental predisposing causes which were basic in causing the disease. Their correction is vital to the permanent cure of the patient and to the welfare of his family. To treat the social ills, therefore, is as important as to cure the disease, for without social rehabilitation the disease is most liable to recur in the patient and continue in his famly.

HOUSING

The housing of a people is a vital factor in determining the health of a community. Certain sanitary requirements are absolutely essential to a healthy home. It is therefore most important that the nurse go through all the rooms, seeing to the proper ventilation, cleanliness, need of repair and overcrowding. She should inspect the toilet, receptacles for garbage and drainage. In addition to teaching the people how to protect themselves and how to improve their ways of living, she must have knowledge of and assist in the enforcement of laws governing landlords and agents. Everything dangerous to the public is reported—dark rooms and halls, closed skylights and airshafts, defective and boxed-in plumbing, filth, damp cellars and overcrowding.

RELIEF

The giving of material relief by the nurses is a question of considerable import. I do not believe the function of relief is a legitimate one for a nurse in connection with a clinic or medical institute, and by relief I mean material relief, whether it be milk, or eggs, or food or clothing. Of course, when we think of public health, we all realize that good food, sufficient clothing and good homes enter into a good standard of health in the community, and those who contribute to these aspects of public health are aiding in the movement, but the nurse is strictly a health agent, a medical social worker, and her field is definite and limited.

Of course so long as there is insufficient income with poor home and the other lack of those material things which go with them, there will be need of relief work, but when we enter the field of relief work we are entering a very large field of social work. The handling of relief is a technical question which requires training and experience, just as much as the handling of health does. All of us who have been in this work a number of years have had to come through this process of travail in regard to relief. We have done it, many of us, and done it a great deal. We have been unable to free ourselves from giving clothing, it is so much needed in this disease and it is the easiest thing we can get to give, and perhaps one of the most difficult things to get from agencies. For instance, some agencies take the ground that clothing, being part of treatment, should be furnished in the budget of the sanatorium, whereas the management of the sanatorium claims they have no provision for this in their budget, so the patients must look elsewhere and are apt to fall between two stools unless the nurse comes to the rescue.

Then the question comes up, what shall we do if we do not give relief. It is, of course, the function of the nurse to see that the things which are needed are supplied, and in my opinion that is the test of a good social worker in securing the cooperation and intelligent interest of other agencies. One of the mistakes which nurses make, and it delays good treatment and educational work, is to refer cases to agencies which are not suitable to deal with them.

The function of the nurse is therefore:

1. To assist in the clinic so that she may be a personal link between the clinic and the homes in which the disease is found.

2. To aid the physician in his diagnosis and treatment by investigation of social conditions and hindrances, and provide him with facts without which he would be blind in dealing with the disease.

3. To arrange for patient's admission to hospital or sanatorium whenever possible when the disease is active, no matter whether it is incipient, moderately advanced or far advanced.

4. To distribute prophylactic supplies and give instruction in care and disposal of sputum.

5. To instruct the patient and all living with him about the proper care of himself, his utensils and clothing, and the precautions it is necessary for the others to observe.

6. To urge the necessity and arrange for the sterilization or destruction of all bedding, clothing, floor coverings, draperies used by the patient during the active stage of the disease.

7. To render all social aid possible for the necessary changes in living and working conditions by referring the patient to the proper persons or organizations, and personally conferring with them in regard to these changes and the necessity for them.

The satisfactory fulfilling of these functions makes a good tuberculosis worker. The tuberculosis nurse must be more than a nurse. She must understand the disease in all its ramifications and be able to make a good social diagnosis.

The Chairman: The nurse in the permanent clinic, of course, has an advantage. She may return and make visits at any time, whereas with the occasional clinic which perhaps visits communities only once a year or once in two or three months, the nurse has not the opportunity for the follow-up work. But there are services which she may render, and Miss Elena M. Crough, State Supervising Nurse, State Board of Health, Manchester, N. H., is going to tell us about that.

THE FUNCTION OF THE NURSE IN THE OCCASIONAL CLINIC

By Elena M. Crough, R.N.

Manchester, N. H.

I am going to you give a few of the reasons that led to the development of the occasional tuberculosis clinic in New Hampshire, and describe the work that the nurses do in developing these clinics and something about the follow-up work.

Basing our estimate on the Framingham experiment, we knew that we had at least 8,000 cases of tuberculosis, and we felt that the most important thing we could do for the people of the state would be to locate these 8,000 cases as quickly as possible, have them properly examined and placed under treatment and supervision, and in that way strike at the very root of the evil.

New Hampshire is a small state with a population of about 443,000. It is made up of eleven cities and 243 towns, and although important industrially, a great deal of the country is of a rural character with farming as the principal occupation. For at least five months of the year, the roads are very difficult to travel, therefore it was necessary to do our most intensive work in seasonable weather and the way most effective to reach the greatest number of people seemed to be through the development of the occasional clinic, locating these clinics in such a way that each one would accommodate many of the surrounding towns and villages and eventually reach all of the rural sections. We have followed this plan faithfully for two years until at the present time nine of the ten counties are completely organized with clinics and nursing service.

There are 26 of these clinic centers scattered throughout the state and since the work began we have examined approximately ten thousand people. The nurses have nearly 3,000 cases of tuberculosis, including suspicious cases, under supervision at the present time.

We are very fortunate in having as executive secretary a physician who is a tuberculosis specialist and examines at most of the clinics. His devotion to the tuberculosis cause is recognized throughout the state and the people are quick to see the advantages of being examined by him.

When we decide upon a place to open our clinic, the supervising nurse, who has been the field agent for the Association, visits the selectmen and tells them a little about the work and asks for suitable quarters in which to hold the clinic. This request is always cheerfully granted,

and in many instances the town has completely furnished and rebuilt a set of rooms for the work. Then the county nurse arrives and the intensive case-finding begins.

We go over the death records for at least six years, noting all deaths that may be attributed directly or indirectly to tuberculosis. We call upon all the physicians at this time and tell them about the work in order to interest them to secure their goodwill and moral support. We ask them if they have any objections to our visiting the homes where there has been a death from tuberculosis, to urge the remaining members of the family to come to the clinic for examination. The doctors have been perfectly fine about the entire work. There is hardly, in fact there is never, a clinic held where doctors do not either bring or send patients for examination.

We also urge the contact cases of home or occupational environment to come to the clinic for examination. We have many ways of locating prospects, through the home to home visits, from the minister, the undertaker, the health officers and the merchants. When patients are sent from sanatoria, the names are immediately sent in to our main office which in turn sends these names to the nurse in whose territory the patient resides, almost immediately the ex-sanatorium patient is placed under supervision. This gives a splendid opportunity for the nurse to enter the home and note the condition of the health of the remaining members of the family.

Physicians reporting cases to the State Board of Health, make a note on the back of their cards telling if the patient needs material aid or home supervision. These names are also referred to the tuberculosis nurse. It has been most gratifying to note the number of cases, or rather the increased number of requests that are coming from private physicians for the tuberculosis nurse to visit their private patients. They feel she is well qualified to give the necessary home instruction and supply the cheer and courage which is often so important in the recovery of the patient.

The nurses are the real case finders. Much of the success of the work depends upon the nurse's personality and perseverance. To do this particular form of public health nursing requires a very unusual type of woman. She must have courage and perseverance and a very genuine love of people in her heart, if she is to be a successful tuberculosis nurse. The nurses are known as tuberculosis nurses, but they are public health nurses in every sense of the word and stand ready at all times to devote their energy and skill to the welfare of their community. Naturally, their first duty is to the tuberculosis cause. The clinics, case-finding and supervision in the homes require the major part of their time.

The home supervision is of the greatest importance; the nurse must have a thorough knowledge of the subject in order to do this part of the work successfully.

In the rural districts we have found that it is necessary to do more or less bedside nursing. If the nurse is able to render real service in this way in a very short time she will find herself a welcome visitor in the homes of patients where previously they were suspicious and inclined to resent her visits. The neighbors will also become interested and friendly and because of this interest and good-will, she will be able to find other patients.

Our nurses also help in the examination of school children in sections where there is no school nurse and are able to do enough follow-up work to correct many physical defects. The school doctor, the school nurse, the district nurse and the industrial nurse all welcome the tuberculosis clinic and in turn render service of great value.

We always visit the superintendents of the local factories, it is quite necessary to have their good will. We point out to them how our work can be of benefit to them and ask permission to speak to their employees at noon telling them something about the clinic work, the necessity for examinations, etc. We also distribute literature at this time.

The interest and co-operation of the superintendent of schools and the local school board is very necessary in order that we may go into the schools and become acquainted with the teachers and the children. We give short talks on health in the classrooms and send home notices to parents telling about the clinic, and the time and place it is going to be held. This is also an excellent opportunity to introduce the Modern Health Crusade. We have been very successful and have Crusaders in nearly every town in the state.

In the last few months there have been several requests from superintendents of local hospitals, that their pupil nurses be allowed to visit or assist at the clinic and do home visiting with the tuberculosis nurse. We are very much pleased, because the nurses who have this opportunity will receive a definite idea of the disease and will have a splendid chance to see the work in the homes.

All of the local organizations are interviewed, such as the women's clubs, parent teacher associations, home demonstrators, etc. and often, at their request, we show moving pictures and give illustrated lectures on tuberculosis. The clergymen have been wonderful all through the work and have proven to be genuine friends of the tuberculosis movement. The Sunday preceding the clinic, they give a little talk to their people, telling them of the work of the Association, what we have done and what we hope to do. They tell their congregation why an examination is a health precaution—if there has been a death in the family that the remaining members should be examined. They also mention the suspicious symptoms of the disease and advise their people if they have any of these symptoms.

The newspapers have been most helpful in giving information to the public; items of interest regarding the probable extent of tuberculosis to be found in the town and the surrounding towns and any other

facts bearing on the problem are printed daily or weekly. As a result of all this intensive work, we are sure to have a large attendance at the first clinic. Up to date, the largest number at the first clinic has been 102, but as the work of the clinic becomes better known, the attendance grows larger and larger, and it is becoming quite a problem to handle it. At a recent clinic, 199 presented themselves for examination. Ninety-nine of these were new patients, and two-thirds of these people came of their own accord. The majority of cases examined are found to have symptoms of the disease, this is undoubtedly due to the intensive nature of the case finding.

We have tried to develop life-extension work among the patients examined at the clinic, by referring every man and woman examined to his or her own physician if there is any need for corrective treatment. The patients at the clinics are met and welcomed by one of the nurses. We endeavor to make our patients feel that there is a genuine heartfelt interest taken in each and every one of them. We have tried to make the people see that an early examination and a thorough examination is a most essential thing, and that health is the first consideration.

Following the clinic, the nurse visits the patients in whom have been found symptoms of disease and also all suspicious cases. She gives the necessary home instructions and returns often enough to make sure her directions are carried out. In sections where there is a district nurse, the follow-up work is much easier, and if any patient is found sick enough to require daily bedside care, the visiting nurse, as a rule, is willing to relieve the tuberculosis nurse.

The advent of the tuberculosis nurse in a community has frequently acted as a stimulus to the public health cause. One of the most forceful illustrations of this took place in a small city. They had a board of health, but it had never functioned very actively, and when the question arose as to where the tuberculosis clinic should be held, the board hired a set of rooms and invited the tuberculosis nurse to make her headquarters there. Since that time, a fully trained public health officer has been appointed, a school nurse has been hired; a district nursing association has been formed with two full-time public health nurses doing general public health work. These changes have taken place in less than two years.

As a rule, the interest taken in the tuberculosis cause by the nurses already in the field has been most gratifying. In some sections there are three nurses working under different organizations. These have been able to develop some exceptional health work; they feel that whatever they do in this line is for the general good of the entire community.

Besides the tuberculosis clinic, eye, ear, nose and throat, and dental clinics have been organized. The nurses speak of those as "our clinics" and take great interest in making them a success. Wherever this true and genuine spirit of cooperation exists, we find much better public health work being done and a very splendid community spirit developing. When

the medical inspectors and the school nurses have a broad public health point of view our work is much easier.

It is often necessary to hold a children's clinic in the afternoon, leaving the evening for the adults. Sometimes 60 children are examined at this time. After the children are examined and any symptom of the disease found, they become the special charge of the tuberculosis nurse, and it is her duty to see that existing defects, if there are any, are corrected. Many of the children are found to be underweight and poorly nourished. We decided that it would be necessary to do intensive work with this group of children if they were to become strong healthy men and women. The relation between malnutrition and tuberculosis is obvious, so each nurse was given a short course in nutrition work, and nutrition classes and clinics have become a regular part of the tuberculosis program. Children showing poor posture are placed in special classes and are given deep breathing and setting up exercises. The children are weighed each week and chest measurements are recorded. The results with these children have been most gratifying and we know that our work with this class of children will be productive of much good in the future.

The interest and support given to the tuberculosis cause in New Hampshire has been very gratifying, both morally and financially. We have endeavored to make the public see the reason or the need for this particular kind of public health work and we feel that we have been successful in a measure. The people in general are recognizing their responsibility in the battle, that this fight is everybody's fight, and the only way to get control of the disease must be through the coordinated efforts of the official and non-official health agencies as well as every individual in the state.

The Chairman: We will now hear from Miss Joan T. Gardner, Supervisor Tuberculosis Division, Association for Improving the Condition of the Poor, New York City, about what the nurse may do in connection with the general diagnostic clinic.

THE FUNCTION OF THE NURSE IN THE GENERAL DIAGNOSTIC CLINIC

By Joan T. Gardner, R.N.

New York City

Every nurse in clinic or field work knows the trying experience of the patient who is sent to one clinic after another before finally reaching the suitable one. Sometimes we are apt to feel a little irritated when a patient does not wish to return to a clinic after the first experience. But how many of us can really appreciate what it may mean to that patient? In the case of a mother, she may be feeling very ill or weak, and usually has to arrange to leave her little ones with neighbors, or drag them along with her. Often after reaching the dispensary or clinic she may have a long wait, amidst crowds of other presumably sick people. Then she goes into a clinic, and after the trouble of getting ready and having the examination, she is told that she must report to some other special clinic; which probably is not open that day. This means that she has to repeat, sometimes several times, the same task.

I quote exactly from a letter which recently came to my desk.

"My dear—

Won't you please excuse me bringing the children to the clinic again. I don't have time to be going for adenoids and tonsils and teeth examinations for I have so much work to do and getting them ready all the time is too much trouble. I think they will be well now, so please excuse me not coming again..."

I have since become well acquainted with this mother. It was not that she was not anxious as to the health of her children, nor that she was not appreciative of the interest being taken by others in her children. She really was overburdened with the constant comings and goings to the different clinics.

Another important thing for us to remember is that attendance at the day clinic often means a day's loss in wages for a man or a wage-earner,—or at least part of a day. To many a man, just earning enough to supply his family with the bare necessities of life, this is all-important. It may be met in some cases by seeing the man's employer and explaining the situation to him, and arranging for the man's time off. There is, however, some danger in this with certain employers. The mere suggestion that one of his employees is in need of clinic care may mean to him that the man is ill, and result in his dismissal. Another way is

to let the man arrange for himself for time off, and pay him for any consequent loss in the day's wage.

These and many other difficulties met with nowadays will, we hope, be solved in the near future by the Dispensary Development Committee in New York City, which is at present addressing itself to the complex questions involved in the scope, organization, and management of clinics and dispensaries. It has opened health centers in various sections of the city near patients' homes, and in these centers very careful general examinations are given and, when necessary, consultations are held. When a diagnosis has been made, the patient is then referred to the proper clinic for treatment, and careful follow-up records are kept of all these patients. As you know, it is usually an extremely difficult procedure to get an apparently well person examined free of charge in any general clinic or dispensary. The Dispensary Development Committee is working in part toward the elimination of much of the often unnecessary visiting at various clinics on the part of patients; and toward the assurance of thorough examinations and recommendations to all who need them, whether they are well or ill.

The need of general clinics is becoming ever more imperative, as the vision of health workers (largely due to war experience) impels them to add to present activities equally scientific work in the fields of nutrition and mental hygiene. Here and there, in a pitiably few instances, these newest branches of science are already making conspicuous contributions in solving the problems of individuals and families. They will rapidly become an insistent argument for their own extension; for example: the conspicuous work which is now being done by a staff of expert nutrition workers in the A. I. C. P. and by the mental hygiene workers of the State Charities Aid Association.

The ideal nurse for the diagnostic clinic is not the one who can successfully meet only the needs which arise during the clinic hours, but the one who can so use her clinic that it becomes in its workings an actual clearing house of very great importance. While her primary function is to give intelligent and efficient service to the patients and physicians during the examination period, this is just touching the edge of the field which lies before her. Is there any question as to the value between the clinic nurse who considers her part of the work finished when she has recorded the diagnosis and recommendations of the physician, and the nurse who in addition to this discovers the difficulties and stress under which the patient may be living and at once sets out to help him in the remedying of them,—not necessarily by her own direct efforts but by interesting other people or agencies in the patient and his family?

Now to be specific let me mention some of the points that constitute the function of the nurse in the diagnostic clinic:

She should have ready for the examining physician as far as possible a concise statement of all illnesses or symptoms, past and present, of each patient, and the reasons for the present need of examination. In our work in the Tuberculosis Division of the A. I. C. P. we often have

families referred to us for medical, nursing, or relief needs. In some cases we are told that the man has worked irregularly for the past few years and has not supported his family. Upon investigation we find that the man has given up job after job for some years past because he has not felt able to continue working. For this reason, he and his family have gradually lost their grip on life in general. A careful physical checking-up shows that the man may have had repeated heavy colds or several attacks of pleurisy, not being quite sick enough to call in a private doctor or go to a clinic; or, if he was examined, enough stress had not been placed upon securing this history and the reason for his repeated loss of jobs. Rather it was accepted in general that he had been too lazy or too indifferent to keep his job. Upon his having a medical examination we find that the man is an active case of pulmonary tuberculosis, and that this for a year or more has been gradually sapping his strength and spirit.

Or take as another illustration a family which came under our care about a year ago. The man had been feeling ill for two years before coming to us, and had spent $2000, the savings of several years, in an effort to get well. He was treated by private physicians for one thing or another, and after his savings had all been spent the family was referred to us for material assistance. Upon visiting, our nurse, besides giving emergent aid, referred the man to the Board of Health clinic for examination, as the symptoms were suspicious; and he was diagnosed by them an active case of pulmonary tuberculosis. It was the clinic nurse who interested herself in this man's family sufficiently not only to arrange for his care at a sanatorium but also for the maintenance of his family, through another agency, until he had regained his health.

Or again; take the case of a woman brought to us by her husband from New Jersey a month ago because she was ill with asthma and greatly run down. She had been advised by a physician that she should get away from her family into the country where she could have complete rest. The clinic nurse became suspicious of pulmonary tuberculosis and sent her at once to one of our tuberculosis specialists, who telephoned us about an hour later that she was a far advanced case with a poor prognosis for recovery. So often cases are in a moderately advanced stage before the condition is even recognized. This early recognition of the symptoms to be looked for seems to be a part of the nurse's work which needs careful thought and study whether she works in the clinic or field.

This general interest on the part of the nurse in the patient carries me into my second point, which is that the patient who comes to the diagnostic clinic should feel at once that she has found in the clinic nurse not only a professional person but an interested friend. In the hurry and rush of the clinic we are apt to lose sight of the human need. A great responsibility is placed on the nurse to give the proper advice and guidance, following the diagnosis of the physician. In many instances patients will need to be referred to special and various clinics. When there will be need of repeated treatments, the nurse should in some way bring home

to the patients the necessity of regular routine attendance at the special clinic to which she directs them, and have a system by which she would actually carry the responsibility of each patient until such patient was registered under the proper clinic.

Our easiest and pleasantest contacts are sometimes with the patients who need only to be advised; but this often requires little thought or effort on the part of the nurse. A real problem comes with the patients who do not believe that they are sick, or at least sick enough to need clinic or hospital care. So often, as you know, they will follow a neighbor's suggestion rather than that given by the doctor or nurse. The nurse who has won their confidence and friendship can do much to control this.

Others will need hospital care, and here again there may be need of much readjustment. The nurse cannot say to a mother or father with several children "You must go into a hospital for treatment," and consider her responsibility ended. Of course there may be great need for hospital or sanatorium care; but how can a father go and leave his family unprovided for? Or how can one expect a mother to leave her children without some one to take care of them? In case of tuberculosis, or cardiac or mental illnesses, freedom from worry for the patients plays a very strong part in their chances of recovery, and this more than we have previously recognized. We, as nurses, are often so intent on the purely health side of our work that we give too little thought to the economic side of family problems. But we find in our work in the A. I. C. P. that health and relief are bound together, that one is a vital part of the other. It is a frequent experience with us to have the fathers, when told that they must enter a hospital or sanatorium for six months or so for treatment of pulmonary tuberculosis, tell us that they are willing to go, but they must first know what their families will have to live on. It is useless to tell them to go and their families will be all right. Fortunately we are able to make out our budget for the family needs and explain in cash terms to the man what will be given to his family; and he goes away satisfied and ready to put up a real fight to recover and again maintain his family. In other words, it is a means by which he still earns a salary and provides for his family.

What, for instance, does it mean to a man with a wife and children, when he has gone to a tuberculosis clinic on the advice of some friend perhaps, or because he has not been feeling well for some time, to be told that he has tuberculosis and that his only chance for recovery is a rest for six months, when he knows that on the day on which he stops work, the wage on which his wife and children depend also stops? I know that the question of giving adequate relief in small towns and rural districts is a big problem, but my experience has made me feel very strongly that adequate relief is just as important from a health point of view as having patients examined and curing defects, and it must so be considered by the clinic nurse. In some places where there are no agencies for this purpose, it may be necessary for the nurse to secure this through her own

efforts. But it is an integral part of the medical treatment and indeed of the whole health program, and often underlies the entire medical treatment. In some cases, such as malnutrition, it may need only a readjustment of diet; but in many cases it is a real need of additional nourishment.

It may seem as though I had wandered a bit from the theme; but this is an important part of the nurse's function, this securing of adequate relief for the families, so that the patients may be able to follow the physician's advice with a mind at rest and ready to do its part in the fight to regain health.

To move to a third point, namely the question of whether the physician or the nurse should assume the responsibility of telling the patient the diagnosis, particularly in pulmonary tuberculosis. It seems as though we attach rather more importance to this question than it merits. Except in occasional instances, most physicians prefer to and do tell the patients. I do not mean by this statement that I have not encountered some cases where the patients have not been told. But it has been the exception rather than the rule that, after the situation has been talked over between the physician and nurse, the physician has refused to assume his responsibility. When the exception has arisen,—well, the nurse should not feel discouraged. Physicians as well as nurses sometimes need a bit of education, and they, after a time, will usually accept their professional opportunity.

It is sometimes very helpful to the nurse, when dealing with patients who cannot believe that they have really any serious physical condition, (even after having been told by the physician that they have, for instance, pulmonary tuberculosis), to talk over very frankly the diagnosis and findings, and to let them have an intelligent comprehension of the amount of involvement, and just what it may mean. I do not advise this as a general procedure, and I know that in mentioning it I am open to criticism; but it has occasionally saved an apparently impossible situation and justified its usage.

To mention briefly another point,—that of the importance of considering and treating the family as a unit rather than merely thinking of the patient as one individual. In our work in the A. I. C. P. the family is so treated. Illness, unemployment, or whatever may be the first reason for a family's being brought to the nurse's attention, we immediately begin our work with the whole family in mind. For this reason we have to see that every need is covered, every defect remedied, if possible, and that before closing the case, the entire family is in a good physical condition, or under the proper medical supervision; that they have an intelligent idea of how to keep well, and an income sufficient to supply at least the minimum necessities of life. It seems almost useless in most instances to send a man or woman away for a prolonged treatment of pulmonary tuberculosis, and then have them return to the same home conditions and ways of living. If the father is away ill with tuberculosis,

the mother and children must be advised and instructed so that when he returns home there will be a hundred per cent. chance that he can remain well, and that no others in the family, who are already predisposed, will break down. In our Home Hospital we admit families where either the father or mother has incipient or moderately advanced pulmonary tuberculosis (with or without positive sputum), and each family has its own apartment. In this way, while the patient is recovering, the rest of the family is also being brought up to the best standard possible, both physically, mentally, and economically.

One final word. I think every nurse is oppressed at times with the knowledge of the vast amount of work to be done, and of how little she can accomplish individually. Let her not be discouraged! Every patient to whom she has taught the principles of health, every person whom she has inspired to be a messenger and example to others, becomes a teacher and spreader of the gospel of health. Yes; and not only of the gospel of health but of those human qualities which I mentioned in the first part of my paper.

"When the desire cometh, it is a tree of life." To the nurse in the clinic, to the public health nurse, whether she finds her work in the rural community or in the tenement homes of the city, there is ever present the opportunity and no less the privilege of implanting the desire that shall bring health of body and soundness of mind.

DISCUSSION ON PAPERS BY MISS STRINGER, MISS CROUGH AND MISS GARDNER

Dr. S. Adolphus Knopf, New York: As one who started anti-tuberculosis work many, many years ago when such a person as a tuberculosis nurse or tuberculosis social worker was unknown, may I embrace this opportunity to pay my tribute to these noble men and women, particularly the women, who have been so helpful to us in combating the medical and social problems of tuberculosis? In an address delivered at the Tenth Anniversary of the Wallingford Sanatorium in Connecticut, I described the ideal tuberculosis nurse as follows: "The ideal tuberculosis nurse should not only have knowledge of sanatorium routine and prophylaxis, but must have a training in social service work as related to public health, and, above all, must have tact, patience and resourcefulness to deal with difficult situations." To these qualifications of an ideal tuberculosis nurse may I add that she must be physically well and strong and mentally alert, able to inspire her patients by her healthy and cheerful appearance. If she herself has had tuberculosis and is an arrested or cured case, she should not hide this fact, for it will rather add to her powers of assuring the patients of the curability of the disease. She must have the same fine qualities of mind and heart which are expected of all physicians, but particularly of the tuberculosis specialist

—cheerfulness, helpfulness, and sympathy, but firmness when this is required.

Besides this, she must of course have an idea of the early symptoms of tuberculosis and also, what is very important, know how to arrange the sanatorium treatment at home, not only for the well-to-do but also for the poor.

Once more let me congratulate the nurses on the work that hundreds and thousands are doing—as good work as the doctors and perhaps sometimes a little better, for I confess we also have our failings. You are a real help in this tuberculosis problem, the solution of which requires ardent work and enthusiasm and hearts of gold, which I know you all have.

Miss Agnes D. Randolph, Richmond, Va.: I was very much interested to hear these papers, because we also try to hold occasional clinics in Virginia, and there are several phases of the work that we would like to discuss and have advice about.

I should like to ask Miss Crough several questions. How many nurses she has on her staff, as she does such a comprehensive piece of work, how long does she leave the nurse in a community for preliminary work and how long after the clinic for follow-up work? Does her nurse endeavor to attend to all of these follow-up problems that come up?

Miss Crough: We have ten nurses on the staff at present. We need many more. It takes just about a week, I have found, to develop these clinics. In a week we can have everything ready and hold a very good clinic. The follow-up work takes about a week after the clinic has been held. The nurses return three or four times a month, depending upon the condition of the patients. We have the same difficulties with the sanatorium work that everybody else has—we are not wealthy, and the number of beds is pitifully inadequate.

Fortunately we were able to impress the Legislature with the need of more beds because of a long list of patients needing sanatorium treatment, and waiting for admittance, and although very much inclined to economize, they gave an appropriation sufficient for 50 beds at the State Sanatorium, and also increased the appropriation for advanced tuberculosis sufferers. This will not begin to take care of the patients, however, because we find so many who have no homes and who should be taken care of in the sanatoria.

Dr. M. W. Newcomb, Brown's Mills in the Pines, N. J.: I think, as Dr. Emerson has said that to be successful in tuberculosis work, one must use good tact in getting the confidence of the patient first, and then use good common sense afterwards. We spend thousands of dollars to discover these cases. I think the amount of good depends, not upon how many of these cases you get, but how many you get under treatment in a sanatorium and out of the house so they will cease to be a source of infection for the rest of the family.

I don't know what the laws are in New York State, but if I discover a case of tuberculosis and send the patient to a sanatorium and something comes up and he doesn't like it, he goes right back home and gets back into the same place he was before, under the same unhygienic conditions. What are you going to do? It seems to me we ought to have some law that would require these patients to stay in the sanatorium.

Dr. A. Robin, Wilmington, Del.: My associations with tuberculosis clinics for some fifteen years have enabled me to see a great deal of evolution in the clinic. Years ago the tuberculosis clinic usually was attended by patients who had been discarded by physicians because they had spent all their money and had become advanced victims of the disease without any resources at their command and had to resort to the clinic. The clinic either gave them help at home, or sent them to a sanatorium.

Since then we have seen the evolution of the clinic, and now, instead of waiting for the advanced consumptive to come to us, we are making an effort to discover and take care of the incipient cases.

Our work in this direction has taught us that about two per cent. of the population have tuberculosis and the only way to discover that two per cent. is to examine the population. That is up to the nurses. My experience has been that the success or failure of any clinic depends, not so much on the medical staff, as upon the nurses. In listening to this conference and the discussions, I have noted that it held exactly the same views, and I think the success or failure of a clinic depends entirely upon the work of the nurses in the field.

A TUBERCULOSIS NURSING PROGRAM FOR THE STATE

By Agnes D. Randolph, R.N.

Richmond, Va.

I feel first as though I ought to make an apology to the nurses because when I was asked to discuss the state program for nursing my idea was that it was going to be a round table. What I have to say about a nursing program is necessarily academic since I have never carried on the nursing work; the supervision of a nursing program for any state and my knowledge of it, alas, is very largely due to my appreciation of the dire need of some such tuberculosis nursing program. I need it every single day of my life and need it more and more.

Further, any American must realize in discussing this matter of a state program that a part of our very glorious heritage as Americans is the fact that we speak practically in different tongues. I am from the South. I was "born and bred in the briar patch" as it were, and absolutely all of my content of thought is influenced by my environment. Even though I did spend a few years in the West and saw health and nursing conditions there, nevertheless I am a Southerner and anything that I say to you today is necessarily colored by that Southern environment of mine. I cannot see a state program from the standpoint of Massachusetts and Wisconsin and Illinois and California. I see it from the standpoint of the South; and although we are dealing in abstractions in discussing a state program for tuberculosis nursing nevertheless that abstraction of mine has the Southern coloring. So I shall have to ask you to remember that and to realize that I am handicapped by my environment just as you are handicapped by your environment; but in all national organizations we must have in mind the North, the East, the South and the West if we are to have real programs for anything.

First of all, it seems to me that we must start with the thought that a tuberculosis nursing program for a state cannot be a separate and independent entity. All success in public health questions rests upon that foundation of public health—nursing. We cannot be successful in the South in the control of typhoid fever, in the control of malaria, and hookworm, and all of our various Southern maladies without a strong foundation of public health nursing. Therefore, no bureau or department of public health nursing should be anything except an independent entity and a whole, dealing inside of that bureau with each one of the phases of public health work.

Tuberculosis nursing cannot stand apart from all other public health activities, but must be a part of a rounded whole. If we are to separate tuberculosis nursing, we will injure the public health campaign. So we must start out with the idea that the public health nursing bureau is a round entity and in that entity lies the department of tuberculosis nursing.

We come immediately to the fact that so pressing and so crowded are the needs of all these various departments and so strenuous is the call for acute work for the child welfare movement and for what not, so pressing are the demands upon our small force, that unless by some means we can constantly bear in mind each one of the phases of public health activity some will get lost. It seems to me that the only way of handling such a situation would be by experimenting with conclusions already reached by a group of thinkers, and using highly specialized supervisors for each one of the phases of public health activity.

We cannot lose any one of the branches of public health nursing without losing efficiency and without losing time; and time with us means the saving of human life; and by the loss of time we mean literally the loss of lives. So we cannot leave out any one of these; and in order to bear them in mind and in order to keep them separate, it would seem that a highly specialized supervisor inside of the rounded-out whole of a bureau of nursing would be the solution of our problem.

In the South we are not so fortunate as some of your Northern States and your Western States, Wisconsin, for instance—I backed Dr. Dearholt into a corner yesterday afternoon and asked him to teach me something about a state program for nursing, as I didn't know anything. We have no law requiring counties to employ nurses. We do have an appropriation for helping a county to employ a nurse, chiefly for child welfare work.

So I come back up against the fact that what I am discussing is an ideal and an abstraction—there "ain't no such animal" down in my section of the country as a state program for tuberculosis nursing.

I am not talking from realities, I am talking from daydreams. So, having a free hand in this matter of outlining a program, I think I should start at it in this fashion: First of all, I should look at it territorially. I should visualize that supervisor sitting in her central office and looking at her map, realizing that her job is to get nursing service into each one of the divisions of that state, and that not until she has put nursing service into each one of them and tuberculosis nursing service at that, has she accomplished her function. Her job is to cover that territory from one end to the other and she must visualize her map and carry it upon her heart and in her mind as a thing to be accomplished, and she will gradually accomplish it.

The reason for that is this: the need of nursing service is no more insistent in the rural and mountain sections than it is in the city.

I will tell you two little anecdotes which made me realize that very thoroughly. Down in one of our cities was my pet, Maria. I have used Maria on more platforms than any other individual and, poor soul, she

is dead. Maria was a tuberculosis case which we demanded should go upon the cure at home and we undertook to supervise her. I used to visit Maria; and, of all the angels, she was the most angelic. She was always flat on her back with her toes turned up to the daisies, windows wide open with nobody ever round her, resting and taking the cure. But I heard she wasn't such an angel when I wasn't there, and so one day I decided I would sneak down there to see her when she was off guard. Early in the morning I arrived at her house, and just as I had anticipated, there was Maria out in the back yard with a huge tub of suds, washing and washing and washing, her arms up to her elbows in suds. She took her hands out of the water, she wiped them on her apron, and she looked at me and I looked at Maria. Presently Maria said, "Now, honey, why didn't you tell me you was a'coming and I would have been in bed for you."

That was in a crowded city. Out in a mountain district of Virginia I was once asked to go to see a consumptive, to see whether he was taking the cure properly. He was shut up in a room with every single window down, and the poor dear soul was sitting in a rocking chair wrapped in blankets with a stove on this side burning full tilt, and a stove on that side burning full tilt.

Nobody knows just exactly how this idea of driving out tuberculosis originated, but it is the method of treating tuberculosis in certain mountain districts of Virginia. So there in the crowded city and there in the mountains, we found ignorance so complete and so far-reaching that nothing could touch it except those visits of education, of sympathy, of instruction, of discipline, of the public health nurse. And so she must consider her territory. But she comes into it and finds it partially occupied, and very largely unoccupied, and what is she going to do about it? There is no use in discussing ideals unless we have some theory of attaining them. What is she going to do?

There are fifty counties in Virginia, half of the total, without nursing care. How are we going to handle them? It seems to me that we can handle them by simply admitting to ourselves that this is as definitely pioneer work as was ever done by any pioneer. Go to pioneer methods to handle your unorganized country. And what were our pioneer methods?

Borrowing, employing a few nurses on a staff, and putting them into the counties for a brief period of time to educate people. That thing called demonstration—it is the best thing, it seems to me, to awaken public interest that I know anything about. Who is going to employ those nurses? Red Cross, tuberculosis associations, any sort of organization that will raise enough money to employ a nurse, not necessarily a tuberculosis nurse, but this rounded complete thing that we call a public health nurse, who, however, must hand in reports to the Tuberculosis Bureau to assure us that when she is there she is doing tuberculosis nursing. And so, going back to pioneer methods, she can cover that unoccupied territory.

Having thus visualized her state and having handled her occupied and unoccupied territory and seen to it that nursing service is provided, then let the supervisor discard that map and forget it, and let her sit down to that much more ominous thing of considering how much individual nursing care is going to be required.

After the territory comes the actual nursing service, the quantity of it, the quality of it, the method of it, everything in connection with it. And first of all she comes to that figure which it seems to me that we tuberculosis workers should never drop from our minds, and that we should carry as a sort of warning to us of the responsibility that we have ourselves accepted. She should always remember the fact that for every annual death there are ten living cases.

In my state, there were last year 3,300 deaths and 33,000 cases; and not until those cases are found, not until they are under supervision, have we achieved the object for which we are striving and should continue to strive.

This is the aim that the supervisor must keep before her; and because it is so stupendous, because it is so continuing, because it is so intricate and so difficult, we have turned our backs upon it far too often and we have said, "We will take up some other form of nursing in which the returns in human life seem quicker." Shall we say to ourselves, "This is too big"? I hope not! No tuberculosis worker must permit herself to say that for one single instant of time. She must wear upon her heart and upon her conscience that that is her job to which she has set her hands.

You can't start out in any state tomorrow and supervise all those cases unless the work has been going on for years and years; but you can carry it as the thought in your heart, the goal to be attained. Then, possibly because I am half Irish, I don't believe in starting out with the thought of supervising the whole 33,000 cases. Cut them in half. Start out with the thought that you are going to cut your death rate fifty per cent. and teach the people that they can cut it fifty per cent. When you have 30,000 or 34,000 cases, tell them, "Well, we will find half of those cases and supervise them and we will get rid of all the rest; we will cure them or we will prevent them, but we will not have them." So after all, when you have begun to cut your death rate you will find that it is a helpful sort of realization that your task is by that much reduced.

You can't go at it wholesale. You can't go into a county or into a state and find those cases and supervise them, and do child welfare work; you can't do that sanitation work that I think the nurses down in Virginia ought to do; you can't do the malaria education that you have just got to do in certain sections of that state; you can't do any of the other things, the trachoma work, for instance. All of that would have to be abandoned if we started out tomorrow to supervise all of those cases. Besides that, we ourselves should be weighted down with the burden we had shouldered. So in a nursing program it seems to me you have to start off with the idea of doing the possible thing.

They tell me that I am an opportunist. I believe in opportunism. I believe in making ideals so huge that they encompass the world and then if anybody says, "I will give you this little corner of that idea," I believe in just grabbing it and letting the rest of it go until somebody else offers it to me. But take what you can get every time and somehow gradually you will get a great deal. So it is in the control or supervision of those cases; start out with the possible. What would be the possible? Well, perhaps it would be simply the supervision of the cases that had already been reported to some department. Personally, in the South we rather despair of that because they aren't reported. So we can't get at it exactly from that angle down there, and I have found myself in making the notes for this talk putting that down third, fourth or fifth. Since you haven't got the reported cases to start out from, what would you have? You might have two sources from which to start your supervision. First of all, there would be the returned case from the sanatorium. You could easily get records of those. Remember, every state spends hundreds of thousands of dollars every year in those sanatoria and if the patients go back home and through our neglect and our indifference, or our lack of thought or sense of responsibility, are thrust immediately into unwise living conditions and break down, the responsibility is ours for two things: for the loss of that life and for retarding the development of the tuberculosis campaign by wasted money and wasted effort, a thing that we can absolutely never afford.

So follow up those sanatoria cases and then get in touch with your laboratory and follow up all the positive and all of the negative sputum cases, and I assure you you will have your hands right full. Down in Virginia when we started that thing three months ago, we put on a clerk. Soon we are going to put on another clerk, and before we get anywhere with it it seems to me we will have the whole department turned into clerks to follow up sputum cases.

With those two things right at your hand, you can find two valuable forces to start with. Your sanatorium case has to be educated in how to live, how to adjust himself. Your laboratory case which is a positive sputum must be educated to go to the sanatorium, and the negative sputum must be watched and supervised to see whether or not that first sputum was right; he must send in more; and there is a whole lot of education to be done with him. So those three groups will give you a good day's work. Then, of course, there always comes the contact work. You can always get the death certificates and find out who your contacts are and follow up your contact work.

Then there is the thing that I have close to my heart. You can always do malnutrition work. Whenever you want to make yourself popular in a community, hold a malnutrition clinic and supervise children. Watch them come right straight up to normal; and note the happiness and the joy of the mothers as the children do come up to normal.

If we start out to accomplish just these tiny, little things (that any

one of us can accomplish), gradually this stupendous whole of ours—the supervision of all cases—will be an accomplished fact.

In that supervision, there are two things to be considered: first of all, the covering of the territory with nursing service in every department of it from one end of that state to the other; and secondly, the supervision of every single, solitary one of the tuberculous in that state. Around those two factors we must build the whole of any tuberculosis nursing program; and although our beginnings may be small the achievement of this organization of which we are each a part has been so great that surely we, of all people, should not be the ones to fear the day of small beginnings.

Whenever I become discouraged down in Virginia I go upstairs and look at a certain wall in my office. Back in 1915 we had a tuberculosis Commission and we wanted to show the Commission the extent of tuberculosis in Virginia; so we devised a perfectly commonplace colored map, the dark colors representing high death rates, the light colors representing the low death rates. In those days, particularly for the colored race, there were no light counties; they were all black, representing the highest death rate; or red, the next, or blue, the next. None of them was light, yellow or white. Those maps hung on our wall as dark blotches of color. As the death rate has come down and as we have saved lives and as we have made those maps year in and year out we now have the line starting with the black and coming down, praise God, to the light. There are a great many counties today that have the light color. I often say, and I know a set of normal school girls recently devised a group of posters around the idea, that what the tuberculosis campaign does is to let the light into the state. It is literally that, it is letting the light shine over the state; and no one of the phases of tuberculosis activities lets the light in more quickly, lets it in more permanently, gives more of the joy of sunshine than this matter of tuberculosis nursing. And by accomplishing the little which is possible for us today we may accomplish that great abstract ideal, which is the perfection that our hearts desire.

DISCUSSION ON PAPER BY MISS RANDOLPH

Dr. Robert B. Kerr, Manchester, N. H.: I think that the address Miss Randolph has just given us is most instructive and inspiring. I can heartily say "Amen" to everything that Miss Randolph has said, and I just want to add a few ideas of my own as we have developed our state nursing program in New Hampshire.

I think Miss Randolph said that she didn't have any definite program to present, but as I listened to her it seemed to me that she presented to you a very, very definite program indeed. She gave you a starting point and from that worked up through a very definite program.

When I went into tuberculosis work some seven or eight years ago the thing which surprised me greatly was this, that so much emphasis was placed upon the educational program, and that which, to my mind, seemed to be fundamental—the great case finding program, the finding of tuberculosis cases—was hardly spoken of. But I think that within the last five years we have begun to realize that we shall never stamp out tuberculosis until we find the tuberculous. They, after all, are the source and fountainhead of the infection. So to my mind in any state if you are going to do any kind of adequate tuberculosis work you have to find those who have the disease; and then after you have found them you have to do those things for them which are necessary to cure them if possible and to prevent their spreading the infection.

Miss Randolph suggested another idea which has been causing me a great deal of consideration and anxiety in New Hampshire, and that is: Just how much tuberculosis nursing is needed? Just how large should your program be? Just how many cases should you try to find? Just how many cases can you reasonably suppose that you can find?

Of course, the ideal would be to say that we want to find every consumptive; we want to find everyone infected with the disease in all stages of the disease: incipient, far advanced and suspicious. And we shall not have performed our full duty until we have achieved that purpose;—that, I think, can be reasonably taken as the ideal.

I don't want to discuss the matter of finding these cases; that was spoken of yesterday afternoon. How much machinery is necessary to find all of the tuberculosis cases in any given state and to provide for them necessary supervision? Here is a mighty big question. I will tell you at the start, as Miss Randolph has already suggested, that we haven't as yet a very definite answer to these questions; and that until we have, until these questions have been worked out and a definite answer has been given to them, we have to go along and work it out as best we can ourselves.

The Framingham demonstration and other surveys indicate that about two per cent. of the population have tuberculosis, about one per cent. of these being active cases and one per cent. inactive or quiescent cases. That, I believe, should be taken as our ideal in carrying out a tuberculosis program in any state.

Of course, clinics and nursing service are your machinery; that is the machinery that is going to find tuberculosis; that is the machinery which should be provided and should be an integral part of your public health program throughout your state.

I liked also Miss Randolph's statement, that the tuberculosis nursing program is not a program of itself but is a supplement, is an integral part of your public health, clinical and nursing program in your state; and until you tie up your tuberculosis program to the various other parts of your public health machinery in the state you are not taking advantage of all the facilities that you should.

Personally, I believe that you will never carry out a tuberculosis program unless you have a specialized service to accomplish that purpose; you must have specialized tuberculosis nurses; you must have tuberculosis clinics, and here I might add that we don't call them public health clinics, we call them tuberculosis clinics. We advertise them as such and invite the people to come for examination for tuberculosis, and it is so understood throughout the state. I believe that the whole work of a tuberculosis program of a state should develop around the tuberculosis clinic and the tuberculosis nurse. I believe that the tuberculosis clinic is absolutely indispensable to the nurse. I don't see how any nurse can go into any county or any city or any town and carry out any kind of a tuberculosis program unless she has a tuberculosis clinic to give her the necessary assistance which she needs to find the cases and to have diagnoses and advice as to the treatment for the individual cases.

Let me tell you, too: your tuberculosis clinic is of no avail without the tuberculosis nurse. Your clinic amounts to nothing without the nurse. So that it is my opinion that the nurse is indispensable to the clinic and the clinic is indispensable to the nurse, and this is your machinery: the tuberculosis clinic and the tuberculosis nurse. If you have the right type of a tuberculosis nurse and the right kind of a tuberculosis clinic you are going to be able to put across a splendid piece of work in any community where you may be working.

The clinic, of course, furnishes diagnoses and treatment and the nurse provides the case finding and the follow-up service. Just how much specialized tuberculosis clinic and nursing service is needed in a state program? Miss Randolph said this was a question in her mind and I will have to state that it is a question in my mind. But nevertheless as we have developed our tuberculosis survey in New Hampshire during the last two years I have come to certain definite conclusions. I can only present these conclusions as my own and not necessarily as the right ones. I will merely suggest them to you as thoughts that have come to me as I have developed in the work.

In New Hampshire we have a population of about 440,000. We have ten counties. We have two large textile and shoe manufacturing cities: Manchester with 80,000 population and Nashua with 28,000. We have twelve other cities of about 10,000 population or over. These cities are largely industrial and textile towns. And of course we have a great rural section.

In December, 1919, we appealed to the people for a complete state tuberculosis program and we asked for sufficient funds to establish and maintain in New Hampshire a system of twenty-four tuberculosis clinics and to provide an adequate staff of twenty-four specialized tuberculosis nurses, to devote their entire time in conjunction with other public health nurses throughout the state, to the necessary case finding campaigns. There were those who felt that we were asking for too much tuberculosis service and that we could not adequately use twenty-four

tuberculosis nurses in a small state like New Hampshire. And mind you, don't think that New Hampshire hasn't good public health nurses—we have! We may be way up in the northern corner of the United States, but we have industrial nurses, we have school nurses, we have district nurses, we have Red Cross nurses, and I think at the present time we have something like one hundred and sixty public health nurses throughout the entire state. In the city of Manchester alone, of 80,000 population we have thirty-three nurses devoting their entire time to a public health program. So we have a good nursing machinery.

The result of our work has demonstrated to me that instead of asking for twenty-four nurses, I should have asked for forty, and that if I had forty tuberculosis nurses in New Hampshire I could carry out a real case finding tuberculosis program in the state. I base this estimate upon the fact that we have found that we need about one full-time tuberculosis nurse to every ten thousand population of the state. We found it absolutely necessary to have a full-time tuberculosis nurse in each one of our larger cities of ten thousand or over; and then we found that we must have a tuberculosis nurse in the rural sections outside of our larger cities.

During the last two years we have examined approximately 10,000 individuals. Of that number we found something over 2,800 had tuberculosis either in a definite stage or suspicious. We have ten tuberculosis nurses at the present time. That means that each nurse has under her supervision about 300 cases. The Framingham demonstration shows that no tuberculosis nurse should take care of more than 100 patients.

What is the result? At the present time we have arrived in New Hampshire at the point where we have a staff of ten nurses, each one burdened with the problem of supervising 300 tuberculosis cases and in addition to that trying to carry out the other case-finding tuberculosis work. We have discovered 3,000 cases of tuberculosis. According to the Framingham figures we have 8,000 tuberculosis cases in the state. Where are the other 5,000? We shall not have achieved our goal until we have found the other 5,000. Possibly we might set our figures as a half of that number and say that we should be satisfied when we have found perhaps 4,000 cases of tuberculosis.

As I said before, our nursing staff at the present time has its hands pretty well filled with the problem of taking care of the 3,000 tuberculosis cases now under their supervision and treatment, and that in order to carry out the further necessary case finding program we must find additional tuberculosis nurses. And, mind you, we have the hearty cooperation of all public health nurses in the state in carrying out this program.

It would seem to me that we could very adequately use a staff of about 40 tuberculosis nurses in New Hampshire. That would give us one tuberculosis nurse to ten thousand population or over and that would provide an adequate staff of tuberculosis nurses to take care of the 8,000

cases if we found them. Let me tell you, too, that it is going to be a bigger job to find them than to supervise them after we do find them. So if I had my forty nurses today we would be doing a mighty big piece of work in finding these cases and after that the job wouldn't be so very, very difficult of providing the necessary supervision.

It might seem to some of you that these things I have said are rather idealistic, but I want to say to you I don't believe they are idealistic at all. I believe they are extremely practical and they are entirely the results of the work as it has developed in New Hampshire during the last two years.

Miss Randolph: I was throwing every particle of the work back upon the localities; although I now have four tuberculosis nurses, and will get another, I was throwing all of the nursing service financially back upon the localities, very frankly, because I knew I couldn't get enough money to conduct it myself. I never dreamed of such a beautiful day coming as to have enough nurses, that is 40 tuberculosis nurses in Virginia. What is the cost in New Hampshire?

Dr. Kerr: Our entire program is financed by the sale of Christmas Seals. We raise as much money as we can.

A COUNTY PROGRAM FOR TUBERCULOSIS WORK

By Mary Van Zile, R.N.

Canandaigua, N. Y.

In the beginning let me say that anything which sounds new or original in this paper is not mine, for I got it from the answers you sent to my questionnaire or from Philip P. Jacobs, Ph.D., or Donald B. Armstrong, M.D., or Mary Meyers, R.N. or from a state document somewhere.

Just here I wish to express my gratitude for the careful consideration given to my questions. When I attempted to quote the good suggestions received, I found it would make such a lengthy paper that you would have no time for discussion. I have tried, therefore, to incorporate the best points in the following outline. This may serve as a basis for discussion of a standard tuberculosis program.

We must realize, as Dr. Livingston Farrand says, that "We are organized for a work of prevention against a disease whose stronghold is ignorance; a disease preeminently of the overworked and the underfed."

The first essential in a county tuberculosis program is, as I see it, the program and that program so firmly fixed in somebody's mind that the county cannot be sidetracked.

In Ontario County when the farmers wish to produce grape juice they plant a grape vine which is a branch of an older well-tested variety. If it is well chosen, suited to its environment, and has the required care it will develop and furnish nourishment and cheer to the needy. In organizing new work we must profit by the experience of older institutions, but at the same time we must be careful to suit the new program to the conditions under which it will be used.

Granting this we must find the person who has digested and assimilated past experience in county work and who has the ability and the vision to correlate those principles to a working plan for this particular county.

What type of person shall this be? Let us think first of the requirements of the program. We know that we must have the background of favorable public opinion, which involves assembling a board of directors who individually and collectively will inspire the confidence of the whole public to be affected, and who will also be representative of the different interests of the community. This board should straightway find, by consultation with other agencies, its place of emphasis—the place where its services are needed and will be acceptable to other organizations.

Going out as the instrument and representative of this board of directors the worker must make a study of the needs of her particular field and of the people who are to be served.

Since we are to formulate a complete program for the care of tuberculous cases let us tabulate the resources provided by county and state in institutions and in other ways. Nothing should be done by a private organization which is required by law of tax payers. That is a waste of private funds. The positive cases must be found and cared for, the contacts detected and supervised, and meanwhile the whole community must be educated along preventive lines. Every possible opportunity should be used by the worker to become acquainted in the county and to give out to the public the general facts obtained.

In this connection we can think of health education as an aeroplane constantly hovering over our county, dropping literature which will give standards of living; the wireless carrying news of what others are doing, the telegraph as an S. O. S. to other workers when we need assistance, and the telephone to gossip about it. Neighborhood gossip carries more information and carries it farther than any other medium. The newspapers will help to spread news of the spectacular kind and can be used for legitimate advertising. But to be effectual the worker must keep her hand on all these instruments.

Our question is, to fulfill these requirements what type of person must we have as a leader?

Listening to conference addresses will soon convince you that all roads lead to "Health Education." All workers know that health education must be carried on from what newspaper people call the "human interest" angle. We must then have the health educator who has the human touch strongly developed—also that instinct carefully trained to service, not to sentimentality nor yet to spectacular value.

Let that attitude of service be the acid test of the worker who is to be the medium between the needy and the giver. With the spirit of service these three personal characteristics are essential: thorough knowledge of the fundamentals of the tuberculosis program; second, organizing ability, which means making others see the vision and making them willing to work toward it, and third, a persuasive personality.

Shall the leader be a nurse or shall she be an executive? Can we get a combination of both? If we cannot now, is it possible to produce such by special preparation?

Granted the best worker we can find for the money we can pay—which is what it comes to practically—what shall we do first?

This is a tuberculosis program. Let us therefore start out to find people who have tuberculosis in the county and those who live with them. Resolved also that our worker shall record every useful fact and follow every clue to personal interest all along the way. In doing this it will be found she has made at least a "study" of the county situation though possibly it cannot aspire to being a "survey." Incidentally we must tell

the county this means an automobile, to economize time and strength, and a stenographer in the office to record and to help broadcast the information obtained. Without these tools progress will be slow and discouraging. An office and telephone have long been furnished for city work. For county work these others, the automobile and stenographer, are indispensable equipment.

When ten patients have been found needing periodic examination and systematic supervision which is not being furnished by private physicians, it is time to hold tuberculosis clinics at accessible places, with a trained diagnostician examining. Dr. Armstrong stresses the point that too much has been required of nurses heretofore and nurses agree with him. They can see and hear and report, persuade and even corral patients, but they cannot diagnose.

Private physicians frequently either cannot or will not pronounce the diagnosis early enough to be of value to the patient. Until they do there must be a court of appeal for the nurse's suspicious case. Just so long as county physicians will wait for a positive sputum to make a diagnosis just so long will it be necessary for the state to supply a diagnostician who recognizes early symptoms and signs.

When the worker has found fifty positive cases, with their contacts, who need supervision it is time to apply to county supervisors for a county tuberculosis nurse who can spend full time on family case work and release the organizer for development of the county program. The care of positive cases of communicable disease is the responsibility of the state or county, not of private citizens.

All this time I haven't mentioned the word co-operation. Perhaps because I dread the sound of it. We don't any of us know what it might mean to have it completely, but we know from sad experience what failure there frequently is for lack of it. Physicians and other organizations will co-operate usually if their rights are recognized and a process of dovetailing of responsibility developed.

We now have a full fledged executive secretary, what shall she do next to lead the people toward their goal—Health? Do not let us forget that constantly while Miss Efficient was doing intensive work in the county she was directing the aeroplane education and the wireless information so that people have become accustomed to the idea of better health.

Of course the more she delegated this propaganda to others the more she has justified her name. She has also used and developed latent talent, which is no small gain to the county. In cities or towns in the county where there is a local nurse, procedure will be as directed by the State Department instructions, i. e.: supervision by the local nurse with monthly reports, better consultations, with the county tuberculosis nurse.

If there is no tuberculosis sanatorium in a county which is of the size to need one, the next step is to begin agitation for that, as a necessary link in care and prevention. While this is pending patients must be sent to near-by county or state institutions, at greater expense to the home county,

which is the chief argument for a home institution. The more patients found who need care the sooner the institution will be provided.

The positive cases being now cared for, naturally we must consider the contacts, especially the children, since these stand only one chance in three of escaping disease after being infected. Free use of the von Pirquet test and careful supervision will soon detect a group of suspicious and below par children who need immediate attention to prevent disaster. Here is the place where the public can be counted on for lively interest and help. For this group of children, too subnormal to be at school, the men's clubs or women's clubs will establish a preventorium—preferably in connection with a general hospital, where each child can have individual medical supervision, orthopedic correction and special diet. With fresh air treatment and a suitable type of teaching, supplied by the board of education, the majority of these cases can eventually be restored to normal condition and wage-earning capacity. This service can be shown to be an economic saving to the county, developing self-supporting citizens instead of paupers.

For the children below par, but not dangerously so, the parent-teachers association will help to establish in the schools nutrition classes and open air classes, thus educating the mothers in individual feeding and health habits and the community at large in health precautions. Family education is the basis of worth-while work as the home is the basis of community life.

This brings to my mind my little patient Victoria who had been trained in habits of hygiene at the preventorium. Two weeks after her return to a low grade home, I asked her how she was getting along. Victoria said, "Just fine, nurse, we have moved across the street now where we have a bath tub." "That's good, Victoria, and you like to use a bath tub now, don't you?" "Yes, and all the family take a bath now, once a week, except Father." Poor child, "father" was quite beyond her educational effort, but she had tried to educate the family.

Health Crusaders in the schools will create enthusiasm and train children to habitual healthy mindedness. Health poster and story contests will clarify their vision of better living.

The school is the most obvious and the best organized place in which to begin preventive work, but there is a whole group of pre-school children and infants who must now be included in our program. At this age the child, not having manufactured its immunity, succumbs to tuberculosis more readily than his older brother. Once in six months a child health consultation should furnish examination of well children and instruction of the parents. Mothers conferences held monthly should supply prenatal instruction and keep the mother in touch for the first six months of the baby's life with the best methods of care and prevention. Introduction to this conference will come through the visiting nurse or by invitation when birth certificates are filed.

When the preventive work for early life has been taken care of, as the

most immediate and pressing need, we must think further of the care of adult contacts and arrested cases, to see that they are instructed and guided toward complete restoration to health. Their working capacity must be measured and work graded accordingly, at the same time that they are instructed in hygienic living and thinking.

The supervision of factory workers is a most important part of a tuberculosis program; to prevent infection from the positive cases, to watch over the arrested cases and, most essential of all, to detect early symptoms and so find incipient cases. With a nurse in the factory the physical examination system can be improved and developed and frequently very helpful adaptations made, suiting the worker to his particular type of work. Handicapped employees can often be given suitable training and opportunity for self support, if they are individually considered.

Patients sick with tuberculosis must be given recreation and employment through occupational therapy and constant cheer through little attentions from volunteer workers.

Every gap and every spare moment (if there be such) in this program should be filled with education and more education—through health exhibits, motion picture parties, workers conferences and publicity campaigns. We can never expect financial support for our preventive work unless we use every opportunity to show the public that it pays in dollars and cents to forestall sickness and produce health.

Such seemingly extraneous matters as good housing, pure milk and water supply, practical city and rural sanitation affect the health of the community so vitally that they too must enter into this preventive program.

At the earliest possible moment as we proceed, each activity, when demonstrated by the private organization, should be turned over to public maintenance. This leaves the thinking leaders of the community free to keep pace with science in advanced methods of prevention.

However since there is grave danger of deterioration in the character of the work under careless management we must see to it that supervision is continued by a group of conscientious private citizens. Until the time comes when we shall have clean disinterested politics we must watch each step in educational work to prevent the lowering of standards. From the executive's standpoint also it has been found most helpful and desirable to retain as advisors those individuals who have become trained in this particular field and are accustomed to meeting its problems.

To quote our leader, Dr. Edward L. Trudeau,

"The success which will attend attempts at the control of tuberculosis by preventive measures,aimed at the infectious agent, will depend upon our realization of the magnitude of the program required to this end, and on the thoroughness with which this program is applied. Desultory, scattered and unrelated measures will accomplish little. Organization, co-operation and co-ordination are the essentials of success. What we need is the thorough application of a well-thought-out program, one in which all the different agencies, such as registration, the dispen-

sary, the visiting nurse, the open-air camp, the fresh-air school, the sanatorium and the hospital for the advanced cases work together as a harmonious and effective whole and not independently of each other."

I like sometimes to say it in Kipling's less elegant way

"It ain't the guns or armament,
Or tunes the band can play,
But it's close cooperation
That makes us win the day,
It ain't the individual
Nor the army as a whole,
But the everlasting team-work,
Of every bloomin' soul."

To summarize, for a county tuberculosis program we must have:

1. A representative group of people who believe in using every available means to give health to the community, individually and collectively.

2. These means shall be used: education, propaganda, instruction and, greatest of all, work.

3. In the beginning a worker shall be employed who knows the fundamentals and requirements of the tuberculosis problem, one who has sufficient organizing ability and also a convincing personality.

4. The program shall be developed along the following lines:

Detection of tuberculosis cases through examination at clinics.

Supervision of contacts by clinic attendance and home visiting.

Resistance building through consultations with parents and home supervision.

Constant instruction and education of the public through exhibits, motion pictures, talks and literature.

Encouragement and training of sick patients by occupational therapy and vocational training.

5. Each activity when sufficiently demonstrated should be maintained by public funds.

6. The staff and equipment should be increased to meet the needs of each activity as developed.

7. The whole program must be imbued with the spirit of helpfulness and suffused with the joy of service.

DISCUSSION ON PAPER BY MISS VAN ZILE

Miss Helen M. Patterson, Dunkirk, N. Y.: It is a distinct pleasure for me to open the discussion on Miss Van Zile's splendid paper. I have in mind at the very beginning that one of the most essential things in this program of county work is the vision of the person or persons who frame it. Think of a shop, a good business shop, where the stock is always

kept up and is appealing to the buyer. Our county program for tuberculosis work must be very much like that, it seems to me. We must have a program that is going to show what we expect to do with the money that is given us to spend by the people, and we must give them a clear-cut, crystal-like educational and demonstrative program that is going to show at the end of the year the results of our work.

As for the leader, to my mind the leader should be an executive secretary and a nurse, who has had experience in tuberculosis work. I feel that she should have a personality that will win the people, the public, to her and to the work that she represents; it is necessary that she should have sympathy for those who are infected with this disease and that she should be able to organize and do the many, many things that a leader of a big and wonderful work is expected to do.

In this program, of course, the clinic work is one very important part. In my mind, I see the rural county because that is where my work lies, in a large, scattered, rural, agricultural section of about 114,000 population, and two small cities. We have over 600 cases of tuberculosis, that we know of, and the supervision of these people who have tuberculosis, of the contacts, the publicity, the educational work, the clinic work, the child welfare work, connected with it, the many things that go to make up this work as a whole, is very, very important.

We sometimes do get discouraged—I know I do—and then I think, "Well it sometimes is the very last key that opens the door, just keep on."

A TUBERCULOSIS NURSING PROGRAM FOR THE CITY

By Mary F. Laird, R.N.

Rochester, N. Y.

I THINK there has been some mistake. We called ourselves a public health nursing association, but since I have been here I find that we are really a tuberculosis nursing association, because we have practically the same aims and plan for our work.

In 1918 the Tuberculosis Association of Rochester got so far in their program as to put on a force of eight nurses. Perhaps if I tell you something about Rochester first you will appreciate a little more what that means. They had no visiting nursing association. They had only two nurses going out from the tuberculosis dispensary, which is the county and the city dispensary.

Rochester has a population of 300,000 and over. It is an industrial city and I learned that there are about 500 industries, 300 with over 50 employees; of course the Eastman Kodak Company has a large number of employees. And there are 200 with somewhat under 50.

During the war and the influenza epidemic, the nursing service was found to be inadequate. The Social Workers' Club, found that there was a very great need for more out-door nursing care. The only nursing service throughout the city was one nurse doing chronic work, three Metropolitan nurses who were working with their industrial policyholders, five nurses doing tuberculosis work and two nurses going out from the general hospital dispensary, and one nurse from the social settlement dispensary. Each group had its own board of directors and each group was doing its own specialized piece of work in that great city.

They found that they had only one nurse in each of five large districts doing tuberculosis work. The Tuberculosis Association had previously made a survey by getting from the Health Bureau the reports of all the deaths and all positive cases which had been reported for the past five years,—we do report there.

They found there were about 1,600 active cases of tuberculosis according to those records so they set their five nurses, one in each district, to finding those cases. They found a shifting population and it took them over eight months to locate a good many of the cases, and in the meantime some had died, and some had moved away, and they felt they hadn't done a very good piece of work. They weren't a bit satisfied after eight months.

Then in 1918 I suppose you all knew that there was an epidemic of influenza. They knew that was probably going to increase tuberculosis and the question was what were they going to do about it? So the

Social Workers' Club got busy—I want you to get that: it was the Social Workers' Club that made the survey and started the ball rolling toward getting more adequate nursing service in Rochester.

They found, as I have said, this small number of nurses doing bedside nursing work. They wanted Miss Crandall to come to Rochester; they got all the representatives of these various outdoor nursing services together and said, "What do you think we ought to do? The Social Workers' Club tells us that we are dealing with our nurses very extravagantly here in Rochester," and they said, "We think we had better get together on it."

They found that everybody was willing to have Miss Crandall come. So the Social Workers' Club financed the visit of Miss Ella Phillips Crandall, then executive secretary of the National Organization for Public Health Nursing and she was asked to come to Rochester and outline some kind of program for them that would be adequate for the great nursing service which was necessary.

The Tuberculosis Association said, "Why, yes, if you want to pool our nurses, we are willing," when Miss Crandall outlined the plan of the nurses, putting them under the direction of one person, keeping the same district divisions and possibly getting the Red Cross interested in helping us finance a larger nursing service. They said, "We will all get together and we will pool our nurses and we will have one board of directors composed of representative members from each of these groups." That worked out very well; they were quite interested in it.

Then, how are we going to have this organized, how can we work it out?—that was the problem. What type of work shall we do? If we went on doing this specialized nursing service, there wouldn't be any infant welfare work done, except what the school nurses who are under the Board of Health do during the summer months in some of the school infant welfare stations. That work was done only during the summer and those of you who are interested in infant welfare work know that it should be done throughout the year.

They decided to try out a generalized nursing service. We have been trying that now for three years. We think it works. But what was the best way to do that thing? We said, "We have got to have nurses who know tuberculosis, who know infant welfare, who will be interested in venereal diseases, who will be interested in all phases of public health nursing, how can we get it over?" We said, "They have been going at it in a rather haphazard way for a year now; let's take longer and do it right from the beginning."

That is one of the principles of psychology: Start right.

We said, "We will divide these nurses up," and when we got started we found that we had fifteen nurses. We made one district a teaching district. We outlined our four months' program of theory which included intensive work in tuberculosis. And do you know, we didn't have one single nurse who had had special training in tuberculosis!

What is the matter with our training schools? I think there is the first great gap in any kind of solid tuberculosis program.

Dr. Lloyd said to me—I hardly dared come here—"I don't think your nurses are doing awfully good work because you are losing cases. Now, you are not trained for tuberculosis work." I began to think maybe we weren't doing awfully good work and I took it up with the superintendents of the training schools and I said, "Why can't we be affiliated with the sanatorium? Why can't we be affiliated with the State Hospital in our training schools? Why can't we be affiliated with some of these other hospitals that are doing such valuable pieces of work? Why do we have to be one-sided nurses?"

They said, "Well, we don't know but we don't think that you can ever work that thing out; our curriculum is too full now."

I talked with some of the tuberculosis people and they said, "We want to start a training school in the sanatorium and we want to have arrested cases of tuberculosis to go in as pupil nurses there to do this piece of work."

Well, now, of course I don't know; maybe that could be done. They say we all have tuberculosis. So perhaps we might possibly as arrested cases of tuberculosis go into the sanatorium and get the training. But I want to tell you the thing that helped us most, besides our four months' course in general public health work: Dietetics, social case work—going right out with the social worker, getting the ideals of the social worker. What is this thing? Why, it is a great big community piece of work. Here is your great big circle of social work and really we are all doing one phase of social work. Perhaps our nursing section is a very small section in that great big wheel but it is a very important one and we are finding now since we have been organized that the social workers are very dependent upon us.

They find that the doctors don't have time to give them a diagnosis and tell them what treatment the family ought to have, so they say, "Well, we will turn that medical side over to the nurse." And when they said, (we had an expert give us our family case work) "Of course, I have never worked with nurses before," I said, "We are very narrow, we don't understand your point of view at all. But," I said, "I think perhaps one of the most important things for you to do is to get the public health angle, to get the nursing and the medical angle, so that you won't disturb all the doctors every time you go into the dispensary with a flock of children, far more than they can take care of; if you turn it over to us, we might use a bit of judgment in getting them there."

And, you know, we had an awfully nice cooperative spirit with the whole group who were doing the piece work. We said, "Now, we stand for honesty. We have got to state facts every once in a while and it is going to hurt like the old scratch when we do, but you are going to stand for it and so are we. We are going to be just good sports." Most of the nurses who are on our staff were in the army; most of them had service overseas and they knew the value of people, and they liked people,

and they came back knowing that they only had a certain period of time to live, and they wanted to crowd that so full of worthwhile things that—well, so they wouldn't have anything to face.

The social workers became very friendly with us. They said, "You all want to join the Social Workers' Club, don't you?"

We said, "Why, of course we do, if you will let us speak once in a while."

They said, "All right," and I want to tell you this: The time they had the Public Health Nursing Association on the program, for that supper there were 200 people there; they had been having meetings of fifty and sixty. So I said, "Well that is the most hopeful thing I know: that you are honestly getting interested in public health."

We said, "What we are in the field for is to do the thing which needs to be done." When we had sifted it all down, after two years of work, we found that we had not sixteen hundred active cases of tuberculosis, but we did find that we had fourteen hundred active cases of tuberculosis that we could put our fingers on.

I don't agree with somebody who said that you must have tuberculosis nurses to do the tuberculosis work, because I think we have proven that generalized nurses can do good tuberculosis work providing they have perhaps the minimum amount of training. Have you set a minimum amount of training that your tuberculosis nurses should have? If you haven't, why don't you? Say, "You can't work with us unless you have it."

We said, "You must visit these families a certain number of times." We now have twenty-seven nurses on the staff; we have five supervisors, one in each district. To be sure, she is a working supervisor, although she doesn't get around a lot. But we have something more valuable than anything else: One of our supervisors became an incipient case of tuberculosis. Well, we were all just simply terrified. What were we going to do about it?

We said, "We will give you leave of absence if you will go to our sanatorium, if you will stay there until our Dr. Lloyd discharges you. We will hold your job for you; we will do all your work for you; and we will take you back when you come out."

She said, "I think I would rather go to ....."

We said, "No, you don't. You've got to go to our sanatorium. We are hearing criticisms. You are going to get an education there that is going to be invaluable to you and invaluable to us."

So she said, "Well, all right, I'll go." Every one of us, the whole force, got together and we gave her a rousing old time before she went. We visited her regularly. We sent the daily papers to her. We went there and said, "What do you know about this now?" We kept her in touch with every single thing that was going on in our whole staff. We said, "What did you learn today? What did you learn yesterday?" She went through three months of hell! She said, "I have no privacy here. I am

with Italians; I am in with everything. It is perfectly dreadful. I can't stick it out."

I wish you could see the letter she wrote to me once. As soon as I received it I got in a taxicab and went there and said to her, "You're no good sport if you aren't going to stick this out and show the people in this pavilion that you are a good deal bigger than they are and help them to live through this period of time."

She said, "I can't do it."

I said, "You've got to; you are going to lose your job if you don't."

So she said, "Well, I will; I'll stick it out two months longer."

Do you know, she was there for eight months, and the last month she was there she said, "You know, this isn't a half bad place."

In the meantime I had had a mother come to me and say, "My little girl can't stay in that sanatorium." We had tried for four months to get that child into the sanatorium and we got her in there for two days when her mother came to me. I made her promise she would come and tell me before she took the child out. She came to me and said, "I am going to take my baby home because they are whipping her."

I said, "Whipping her?"

"Yes, they are."

I went up there and got hold of the superintendent of nurses and said, "What are you whipping that child for?"

She said, "Why, I don't know. We haven't whipped her. We have the finest kind of nurse with the children."

I said, We have got to sift this out." And that is one thing we have done: whenever we got a complaint we took it right to the sanatorium and said, "Here is this thing which they say is happening. Of course, we know it didn't happen but we want to get an idea of how that rumor started."

What do you suppose happened in this case? When this child went in she was coughing. They isolated her, for the first twenty-four hours because they thought she had whooping cough. When the child's mother went up to see her the child said, "They are punishing me. They keep me in here alone." So the mother came to me and said they were whipping her.

That is how some of the things get around the city and I believe it is the duty of every tuberculosis nurse or public health nurse—I think you can use the terms interchangeably after this convention, I am sure you can,—to go back to the sanatorium with the complainant and make them see reason. Say to them, "Now, you just wait! The reason we wanted you to go there is because we are your friends and we were interested in you; so much so that we want your child, (or your whoever it is) to have a chance and we want the rest of you in the family to have a chance." Go up to the sanatorium and tell the officials what is being said and take the people who complain with you and say to them, "Now, you see this is what we find."

Since our supervisor came home from the sanatorium she has given

us as intimately as she could the ideas of these people—and she got acquainted with pretty nearly everybody in the sanatorium when she was there.

Let me tell you one thing she found, and I believe it is a great criticism on all tuberculosis workers. She said, "I answered this set of questions five times—the same questions."

We said, "How does that happen? We only ask questions first in getting the family history."

She said, "Well, in the dispensary they asked me all this long list of questions. The nurses asked me that"—we made her do the whole thing, you know; we made her go to the dispensary to be examined because we wanted to learn how it was done. The doctor asked her another lot of questions. Then the financial investigator asked her pretty nearly the same things. Then when she got there the examining physician asked her pretty nearly the same questions, and the nurse in the ward asked her the same things. Then when she went back to be re-examined they asked her the same things over again.

She said, "That is pretty hard work when you have a foreigner, you know, because it takes a long time to get these questions."

So through the Community Chest and Tuberculosis Association and the Dispensary, we said: "Let us have a functional group meeting of everybody who is interested in tuberculosis in the city, the industrial nurses, the dispensary group, the tuberculosis dispensary group and the public health nurses."

They all agreed, and that was one of the things we brought up: Eliminating unnecessary questions; the technique in the care of tuberculosis, and how can we avoid overlappings. Our supervisor and our teaching supervisor and I worked out what Dr. Lloyd says is a "bully technique" in the care of the active case of tuberculosis. I brought it with me, if anybody wants to see it. I have only one or two copies; maybe you all know it. I have learned since I have been here that you know a lot more than I thought you did. We have adopted that program as our standard and it is so far above what we can do that we don't know how we are ever going to get it over. We have asked for six additional nurses that we may have thirty nurses doing public health nursing; instead of having five nurses doing tuberculosis work alone we are going to have thirty nurses doing it as part of their work. I believe that is the way to do it.

I want to tell you about one case we found which stands out in my mind. One of the physicians who fought us when we first started our work just didn't like us because he thought we were tied up with tuberculosis more than anything else. He reported a case to us, a woman who needed nursing care. He told us that she had an abdominal condition; she had been in the hospital and had an abdominal operation and her trouble was rather obscure, we could get no diagnosis. The first nurse who went in said she was coughing a great deal, raising in the morning,

and said she didn't know just what we ought to do about it. I said, after discussing the case with our medical advisor, "Let's do this: Everybody who is coughing will have to have a specimen of their sputum sent to the Health Bureau for examination. Then we can say to all the doctors that that is one of our standing rules, and we will do it with everybody." They agreed that we should do it. We made the rule from that minute. We telephoned it to all the supervising nurses and sent a bulletin around to each district office saying, "This is one of the things we must do; we must get specimens of sputum from all the suspicious patients who are coughing at all." We suggested we would put it this way: "Make it popular because everybody is doing it."

They started it and they got a specimen of sputum from this patient. I called that physician and said, "Just what did you want done; what are the special orders for this patient?"

He said, "I don't know; why, just general care."

I said, "Well, what is the trouble, Doctor?"

He said, "It is a little bit obscure yet."

I said, "She has been in the hospital?"

"Yes."

"You have had all the tests taken on her? Have you by any chance had her sputum examined?"

"Why, no."

"Well," I said, "you see, it is one of our standing orders that we send a sputum specimen for examination of all of our patients who are coughing. Have you any objection to our sending a specimen of her sputum?"

"Why," he said, "it is absolute nonsense, but as long as it is one of your standing orders I guess it is all right."

That sputum was loaded! And he was the most surprised man in Rochester.

That is just one way of doing it. As for finding the incipient case, of course, almost anybody ought to know; although we are never supposed to make a diagnosis, we can always say things are suspicious.

With regard to the children, we are able to persuade them to go up to the preventorium for a while if we take the time to take the mothers up there to look around and see how happy they are there. That helps, you know. We haven't any car and we have to have a taxicab; and that brings our bills up a good deal. Sometimes we can get volunteer workers, but if you take one of these Italian mothers out riding in a car she thinks it is the grandest thing!

I like Miss Randolph's idea of not trying to do everything at once, but when you start to do one thing, try to do it well enough. If you want to make a dent on some of these people, take the time to do it; take your hat and coat off. When the nurse goes into the house, she should go in as if she were going to stay. The generalized nurse always has something to do when she goes in; she goes in and finds something else; she doesn't go in to take care of tuberculosis.

Some of the tuberculosis nurses who are going around didn't wear a uniform. They said if they didn't wear a uniform the patients wouldn't object to them so much. Because that nurse went in to take care of the new baby that came, because she went where there was a communicable disease, because she went in to do bedside nursing for the chronic, those people say, "Well, she went in where the new baby was born; I guess maybe they don't think we have tuberculosis here; we will let her come in."

You are all talking about personality. It is a wonderful thing. I would always pick a nurse out for our staff because she likes people; I would pick her out because she has the ability to learn what people want to do, because she knows behavior under given conditions,—she may not call it psychology, but because she knows how to work with people and with physicians. If you are going to step on the toes of the doctors you are never going to get anywhere for first, last and always we are in the field for the community, for the patient; but we work always under the direction of a physician.

I believe you are going to get farther with your diagnostic clinics with one section roped off for tuberculosis and having them see that it isn't any disgrace to have tuberculosis but that it is a mighty big feather in their caps if they get over it. We have always got to adjust your lives to that chest condition or that heart condition and we are going to do it in the happiest possible way if we don't think there is any disgrace about it.

This nurse of ours who had tuberculosis goes out now saying, "Why, surely, I have been up in the sanatorium myself. I did all the things up there that I had to; I hated it at first but I stuck it out for that long time and got so I liked it." And all the rest of us go around saying, "Why, yes, one of our nurses was up there. It is not a bad place to go to at all. Go up there and get trained. Why, it is a school, that is what it is—it is a school. Education is the thing these days. Everybody wants a liberal education. You go into the sanatorium and it will be a liberal education." And it is. It is a great test for one.

That is the way we think we have put our tuberculosis program over.

DISCUSSION ON TUBERCULOSIS NURSING PROGRAMS

Miss G. I. Pelton, Denver: I did not come to discuss or to criticize. My only criticism is that everything we have heard today has been most helpful but a large per cent. of our tuberculosis problem is in the states west of the Missouri River, and I want to make a very earnest plea that this Nursing Section remember us who are doing tuberculosis work in the West, and another year allow us to present some of our nursing problems.

We have as you know the worst tuberculosis death rate in the country

in Colorado. We have no state sanatorium. We have in Colorado only one open-air school. From one-half to two-thirds of our counties have no public health nurses. To give you an idea of how large our state is, it takes as long to go from one side of Colorado to the other as it does to go from Washington to Chicago; and two-thirds of that territory has no public health nurse. One of the worst tuberculosis death rates in this country is in a large county in Colorado where there is no nurse at all.

We need your help. You have given us a lot of it this morning, but we want you, if you will, to apply all the wonderful experience and knowledge you have to some of our problems and to try to help us work them out. We have some unusually fine nurses in Colorado. Most of them are from the East. They have the pioneer spirit; they are doing strong work. I should like to be able to take back, and I am going to take back, some help to them from this meeting.

I, too, can quote Kipling, only I hope Kipling isn't true in this quotation:

"Oh, the East is East and the West is West
And never the twain shall meet."

I am going to ask that next year you will give our western nurses a chance to meet with you.

The Chairman: I think this would be a very good time to consider for just a moment the subject of the training of nurses in tuberculosis in the training school. This Section, as you know, has been working on that for some time. We do know that this is our crying need, —some training, some practical work or at least some good theoretical work in tuberculosis in the training schools. Miss Chetwood is on a committee that has been working on the possibilities of affiliation in sanatoria or the working out of some method by which pupil nurses may get a little training in tuberculosis. Will Miss Chetwood tell us what has been accomplished?

Miss V. M. Chetwood, Hackensack, N. J.: A year ago I sent a questionnaire to 39 schools of nursing in New Jersey, asking if tuberculous patients were received in their hospitals, if education were given their students, and if affiliation with local or state sanatoria would be considered. I regret that my statement is not here. Replies were returned from 26 out of 39 superintendents. The new municipal hospital in Jersey City was the only one having ward service. Some received such patients for observation, in others the tuberculous were admitted under wrong diagnosis, in both instances for a very short time. A few schools gave their students a very limited clinic experience, while others did not even give a lecture on the disease.

The best instruction is given in Hudson County. Together with the medical instruction, the superintendent of nurses of the Hudson County Tuberculosis Clinics lectures to three schools on the clinic and social side of tuberculosis nursing.

The New Jersey State Organization for Public Health Nursing appointed a special tuberculosis committee, of which I happened to be chairman. With Miss Emma Allen, Hudson County, and Miss Beulah Bain, Montclair, we worked out a plan for securing a nurse member in every county who should interest the hospital authorities in tuberculosis education and the alumnae associations in tuberculosis work.

At the same time the nursing questionnaire was sent. One went to the sanatoria superintendents, of which there are eleven. Six replied. This questionnaire related to affiliation with the general hospital, number of students to be received, length of stay, and instruction to be given. Five sanatorium superintendents will receive the student nurse for an indefinite period. The State Sanatorium, the Union County Sanatorium and the Hudson County Sanatorium outlined their plans. To each hospital, sanatorium, to the State Medical and County Medical Societies was sent a copy of the resolutions passed by the American Medical Association in June 1921, regarding the care of the tuberculous in general hospitals, and to the institutions there was sent, in addition, a copy of the outline of lectures compiled by Dr. Pattison and Miss Marshall. This plan has not been fully carried out; our nurse members are not all selected and working, but it is beginning.

The Chairman: I don't know whether this subject was included in a state nursing program or not but I think it should be. Miss Mary Meyers, of Indianapolis, who is the chairman of the Tuberculosis Section of the N. O. P. H. N. is pushing state directors very hard on this question and I think many states are beginning some such work as Miss Chetwood has done. We hope at the Seattle meeting to have a very good report from each state showing that there is some work being done on the education of nurses in tuberculosis.

Miss Pelton: I should like to say one word for the nurse who has tuberculosis. A very large number of nurses in our state who are doing the best public health work are cases of arrested tuberculosis.

Miss Delya E. Nardi, Rutland, Mass.: I want to tell of the work that is being done mostly among the ex-patients at Rutland who become nurses. Rutland has a training school, incorporated in 1908. At first there were about twelve nurses in the training school and most of them were ex-patients. Patients that were incipient and possibly advanced cases had become arrested and had taken the training.

Since 1918 the Rutland State Sanatorium Training School has graduated forty nurses. Today we have thirty-two nurses in our training school. We have an eight months' affiliation, four with the Milford General Hospital for obstetrics and surgery and four with the Worcester City Hospital for children's diseases and medical nursing. Since October 1920, twenty nurses have been able to take the training at Milford and not any have broken down. Since 1922, our training is a three years' course on account of the registration laws in Massachusetts. Previous to that,

the nurses were allowed to take the State Board examinations without being affiliated.

We are supplying nurses to hospitals and sanatoria throughout the country and some of them have become superintendents of small county institutions; they are doing public health work; they have joined the service and are night superintendents in Government hospitals and are also doing private nursing.

I would like to ask if any of the nurses here know of women who would like to take the training at Rutland? I would be very glad to have them send for full particulars regarding our training school. I believe that ex-patients make the best tuberculosis nurses as there is a bond of sympathy between the nurse and patient which I think no other nurse is able to acquire. Ex-patiens take to the work more readily. There is a feeling among patients that general hospital nurses are afraid of tuberculosis. The former become better acquainted with the patients and with the nursing of tuberculosis in general.

Mr. D. McL. McDonald, Columbia, S. C.: I want to endorse most heartily what the two speakers have just said about ex-patients making good nurses. I am not a nurse nor a doctor, but I am a T.B., with something like fifty hemorrhages on the credit side of my ledger and I want to say this from my own experience. During the seven years that I have been fighting tuberculosis I have been in the hands of something like fifteen doctors. This was not due to any desire for change but because I was in different places during that time and required the attention of different doctors. These men made good suggestions about treatment, but with all due respect for their kindnesses and good advice not one of them knew how to handle my case effectively except Dr. McCain down at the North Carolina Sanatorium because none of these men had had personal experience fighting tuberculosis themselves, exept Dr. McCain who could pretty nearly match me on the hemorrhage question. When a fellow goes down with tuberculosis he wants a bond of sympathy; he wants contact with persons who can understand his condition.

So far as training is concerned, I should like to say this: I wish that every person going into tuberculosis work would cut himself off from his home and source of income; get on his back; appeal to some charitable organization for help; be sent to a clinic and then to a sanatorium for six or eight months. If this could be done the work that is called effective now would compare very poorly with the work that would be done then for then doctors, nurses and social workers would have some real understanding with which to help a tuberculous patient.

The Chairman: As you know, the United States Public Health Service program is being rearranged, following the transfer of the Service hospitals to the Veterans' Bureau, and it is feared that their summer course or institute for tuberculosis workers may be discontinued. They

would like very much to have an expression of opinion from this group and I am going to ask the Secretary to read these resolutions.

The Secretary: WHEREAS, it has been found difficult to secure for service in hospitals caring for veterans suffering with tuberculosis a sufficient number of nurses qualified in the care of tuberculosis patients to staff these hospitals, and

WHEREAS, the school conducted by the Public Health Service at Hospital No. 60, Oteen, North Carolina, from September 1 to 30, 1921, for nurses serving in Public Health Service hospitals has proven of great value, and

WHEREAS, advantage can be taken of the presence of qualified physicians to give the lectures, and of all the facilities that are in existence at Hospital No. 60, Oteen, North Carolina, be it

Resolved therefore that it is the sense of this meeting that the course should be conducted under the auspices of the Veterans' Bureau June 1 to 30, 1922, as proposed by the Public Health Service and that these resolutions should be forwarded to the Director of the U. S. Veterans' Bureau for his consideration."

The Chairman: What would you like to do with these resolutions?

Dr. James Alexander Miller, New York: I think this resolution is a very important one because it has its bearing not only on the nursing program but also on the medical program. Some of us have had opportunity in the past few days to consult with the medical staff of the Veterans' Bureau. As probably you all know, all of these hospitals have been transferred from the Public Health Service to the Veterans' Bureau and there is a very considerable amount of concern lest this transfer will very materially affect the efficiency of the service both medical and nursing. Some of us feel that the whole program is in great danger of breaking down because of inefficient or ineffective personnel, and I think, therefore, that anything we can do in the way of carrying out the well known wishes and plans of the Public Health Service will be worth while. If this Section would pass this resolution and then turn it over to the Committee on Resolutions of the Association, Dr. Kober being Chairman (and they will meet at two o'clock), I think it would help very materially to uphold the hands of the medical staff of the Veterans' Bureau, and it is a very important matter.

The Chairman: May we have a motion for the adoption of these resolutions?

It was voted upon motion duly made and seconded that the resolutions as read be adopted and referred to the Committee on Resolutions of the National Tuberculosis Association..

AMERICAN SANATORIUM ASSOCIATION

SEVENTEENTH MIDWINTER AND SPRING MEETINGS

SEVENTEENTH MIDWINTER MEETING OF THE AMERICAN SANATORIUM ASSOCIATION

The Seventeenth Mid-Winter Meeting of the American Sanatorium Association was held at the Essex Sanatorium, Middleton, Mass., on December 3, 1921, the president, Dr. Lawrason Brown, presiding. The meeting was attended by approximately fifty members and guests, including the staff of the Essex Sanatorium.

The secretary presented the following names of applicants for membership, all of whom were elected:

Dr. C. F. Arroyo, Tampa, Fla.
Dr. W. E. Carroll, Meriden, Conn.
Dr. Eugene R. Kelly, Boston, Mass.
Dr. Roy Morgan, Westfield, Mass.
Dr. Adam S. MacKnight, Attleboro, Mass.
Dr. William H. Ordway, Jr., Mt. McGregor, N. Y.
Dr. Nahum R. Pillsbury, South Braintree, Mass.
Dr. Alfred J. Roach, South Braintree, Mass.
Dr. George H. Shaw, New Dorp, Staten Island, N. Y.
Dr. Francis J. Welch, E. Parsonsfield, Me.

There were no resignations, but the deaths of Dr. H. J. Blankemeyer of Gabriels Sanatorium, Gabriels, New York, and Dr. B. L. Taliaferro of Catawba Sanatorium, Virginia, were reported by the secretary, who stated the present membership to be 240, with about thirty members in arrears with dues. He was instructed to drop these delinquents.

The treasurer's report was read, and the usual auditing committee appointed. After the books had been duly gone over, the report was accepted.

The President appointed Doctors Bowditch, Cullen and Clarence Hyde as Nominating Committee to propose officers at the annual Meeting in May.

Dr. Pattison of the National Tuberculosis Association reported that the suggestions of the joint committee of this Association and the National Association on the "Condition of Soldier Institutions," have been found of much value. He also requested that some action be taken in the matter of the sanatorium extension project brought up at the previous meeting. This request was referred to the Executive Committee.

Request was made from various sources to announce vacancies in medical positions in sanatoria, which were read to the Association.

On motion, the following resolution was adopted:

January 10th, 1922.

WHEREAS, The American Sanatorium Association heartily approved the publication of the AMERICAN REVIEW OF TUBERCULOSIS, and welcomed its appearance, and

WHEREAS, The American Sanatorium Association regards it as a valuable adjunct to the proper conduct of every sanatorium and hospital for tuberculosis, and believes that it should be read by every superintendent and assistant physician in every such sanatorium and hospital,

Resolved, that the American Sanatorium Association urge every tuberculosis sanatorium and hospital, more especially those represented in its membership, to subscribe to the AMERICAN REVIEW OF TUBERCULOSIS, if they have not already done so, and see that it is made full use of by the medical staff.

A resolution of appreciation was passed to the Massachusetts State Board of Health, and the Trustees and Superintendent of the Essex Sanatorium for their hospitality.

The Association was entertained at dinner at the Boston City Club by the State Department of Health of Massachusetts.

An invitation was received from Dr. Cohen of the Eagleville Sanatorium, Philadelphia, to hold the next meeting of the American Sanatorium Association at that institution.

The regular scientific program was then proceeded with as follows: "Symposium on Tuberculous Children and Their Care."

Discussion was opened on the following phases of the subject by Dr. Henry D. Chadwick, "Classification of Juvenile Tuberculosis"; Dr. W. A. Griffin, "The Need of Sanatorium Treatment for Tuberculous Children"; Dr. Walter L. Rathbun, "Diagnosis"; Dr. John J. Lloyd, "Physical Signs."

CLASSIFICATION OF JUVENILE TUBERCULOSIS

By Henry D. Chadwick, M.D.

Westfield, Mass.

I approach with much temerity the task of proposing to this Association a classification into which we may group the large number of cases of juvenile thoracic tuberculosis. The plan I present to you is made in good faith and I hope it will lead to much study and discussion and that out of it may be developed a classification that is consistent with the pathology and the course of disease as it is found in childhood.

We are still wrestling with the schema of classification first adopted by the National Tuberculosis Association in 1905. Repeated efforts from time to time have been made to define, limit and modify that classification. We have tried in this way to keep abreast of the advances made in our knowledge of pulmonary disease. In fact, it is an evidence of progress and indicates a more careful study of our patients, aided in large measure by the greater degree of excellence in x-ray technic. It is much easier to criticize than to construct, as no doubt all the men have discovered who have labored at various times to formulate and perfect our present classification.

The schema now in use was intended to apply to the adult type of tuberculosis, which is distinctly pulmonary. But more recent investigations by the pathologists and clinical experience with children both indicate that there is a definite juvenile form of tuberculosis that first affects the lymph nodes at the root of the lung. It is primarily interpulmonary and may or may not later produce lesions in the lungs.

The need of a different classification for these cases has been brought forcefully to my attention during the past ten years, during which I have had under my sanatorium care about 1,200 boys and girls between the ages of three and sixteen years.

A large number of these children had definite lesions of the tracheobronchial lymph nodes but without much if any involvement of the adjacent pulmonary tissue.

The last year we have been making routine x-ray films of all patients and it is rare indeed to find a child under twelve that has a definite apical lesion. These young children usually show a few dense bronchial glands and a thickened hilum from which shadowy masses project outward in irregular forms into the substance of the lung. The bronchi, extending to the second or third interspaces, may sometimes seem abnormally prominent, but there is no other definite pulmonary involvement.

These cases react to the von Pirquet test. They have symptoms consistent with a tuberculin toxemia such as lassitude, anorexia, nervous irritability, occasional or irregular periods of low grade fever, and they are usually undernourished. Physical examination shows a D'Espine sign and paravertebral dullness. There is also a definite impairment of resonance extending upward into the suprascapula fossæ in many of these children.

The roentgen picture, however, does not show apical infiltration. It would seem, therefore, that this change in resonance must be due to muscular spasm produced by some reflex from the inflamed tracheobronchial lymph nodes.

Childhood tuberculosis is a distinct type in that the lesions are found in the lymph nodes about the trachea, the bronchus and its larger subdivisions. It may involve the lymphoid tissue that is in close contact with the branches of the bronchial tree and then later produce lesions in the adjacent tissue. It rarely involves the apices in childhood, but when this does not occur in advanced cases we have then the adult type of pulmonary disease.

It has never seemed to me consistent to classify a child without any pulmonary lesions but with definite bronchial adenitis, probably tuberculous, in the same group with adults who exhibit lesions to the extent that is defined under the term incipient or minimal. It would be just as logical to classify children having cervical adenitis with adults having apical tuberculosis, which, of course, would be an absurdity. I, therefore, suggest that the term bronchial adenitis be applied to children without pulmonary involvement but with definite enlargement of their bronchial glands accompanied by symptoms such as are produced by tuberculous disease.

Second; that the term incipient (juvenile) tuberculosis be used to describe the condition found in a child when in addition to the diseased tracheobronchial glands there is evidence of an extension into the pulmonary tissue as shown by peribronchial thickening, with or without slight mottling in the adjacent parenchyma.

SUMMARY OF PROPOSED CLASSIFICATION OF CHILDREN HAVING THE FOLLOWING SIGNS AND SYMPTOMS:

Bronchial Adenitis:

Symptoms: Weakness; undue fatigue; nervous irritability; anorexia; malnutrition as represented by underweight, failure to gain or loss of weight; occasional unexplained elevations of temperature of 99.6 to 100; cough may or may not be present; phylctenular keritiitis or conjunctivitis is not of infrequent occurrence.

Physical signs: Percussion reveals dullness in the area between the scapulae and often extending upward toward the supraspinus fossae. Parasternal dullness. This may be erroneously interpreted as due to an enlarged heart, especially when noted to the right of the sternum.

Ausculation: The D'Espine sign is present below the second dorsal spine. Voice and breath sounds are usually normal.

Roentgen findings: Diffuse shadows of varying density throughout the hilum and frequently extending from its borders are cloudy masses with irregular outlines projecting into the substance of the lungs. Nodules varying in number and density, corresponding in size to enlarged lymph nodes, can be seen imbedded in the shadowy tissue of the hilum.

INCIPIENT (JUVENILE) TUBERCULOSIS:

Symptoms: May be the same as in bronchial adenitis, depending in each case upon the activity of the tuberculous lesion.

Physical signs: May or may not show a greater area of paravertebral or parasternal dullness.

Roentgen findings: Will show in addition to the shadows described in bronchial adenitis an increased visibility of the bronchial tree in the second or third interspaces. The outline of the bronchi are fuzzy and nodular and there may be slight mottling in the adjacent parenchyma indicating beginning infiltration.

Von Pirquet test to be positive in both classifications.

THE NEED OF SANATORIUM TREATMENT FOR TUBERCULOUS CHILDREN

By Walter A. Griffin, M.D.

Sharon, Mass.

In considering the need of sanatorium care of children one is struck by two facts: one is the present paucity of accommodation as compared with accommodation for adults, and the other is the reported high rate of incidence of tuberculosis in children. Many writers have made mention of this latter point. Thus, Hamberger and Monti, in Vienna, are responsible for saying that 95 per cent. of children between the ages of twelve and thirteen years who came to autopsy showed infection with the tubercle bacillus. Garrahan[1] examined 1214 children between the ages of two and sixteen and found 75 per cent. between the ages of fourteen and sixteen probably affected with tubercle, although apparently all of these children appeared healthy. Brenner[2] examined 114 children and considered 65 per cent. positively tubercular, as revealed by x-ray examination. We have to take his further word, however, that only three of these showed definite pulmonary signs. Hess[3] found over one-third of the homes represented by children at the Preventorium in Farmingdale had infants under two years in close contact with tubercular parents. Ayres[4] in his book, "Open Air Schools," considered that out of 90,000 Boston school children 4489, or nearly 5 per cent., needed the special open-air school and, as Kingsley[5] says, "If 2 per cent. all over the country should need such care, 400,000 would need it." Finally, the annual report of the City of Chicago Municipal Tuberculosis Sanitarium makes mention in one place that there are more than 13,000 children under sixteen years of age registered in the tuberculosis dispensary, and 9000 of this number have been diagnosed tuberculous. These figures are certainly startling and would indicate that almost any large city in the country could furnish enough children with tuberculosis to fill all of the existing tuberculosis sanatoria in the land. Further, if these observers are anywhere near the truth in their deductions, there is a tremendous incidence of childhood tuberculosis. In fact, many have said it is probable that everyone in civilized communities is affected with tuberculosis by the age of twenty-five.

In compiling such statistics, it becomes necessary to know what signs and symptoms have been considered by these writers of sufficient weight to warrant the diagnosis. Even a question of doubt may arise as to the sureness of tuberculosis being present in a number of the investi-

gations. We find that some of the observers rely on history alone, and, according to their reasoning, an infant in close relationship with a case of tuberculosis becomes necessarily tuberculous. Others are sure that they may detect by physical examination whether or no the tracheobronchial glands are enlarged, and if they are enlarged by such findings they are considered to be tuberculous. Not all examiners will agree to this nor to the assertion of other observers that x-ray examinations disclose such great numbers of tubercular glands within the chest. Those cases that are diagnosed by the aid of tuberculin are probably correct, but unfortunately any tuberculin reaction does not tell us whether an active disease condition is present or not, and, therefore, whether immediate treatment should be instituted. In fact, in many cases mention is made of the healthy appearance of the children so tested. Those cases that are found at autopsy have died, usually, of some intercurrent disease and the focus of tuberculosis is usually limited to small, well walled-off glands. Finally, we have always to bear in mind that infection with tuberculosis and tuberculous disease resulting from such infection are two quite different things.

Unfortunately, there are many among the laity who are far from willing to admit from the evidences cited that the erection and costly maintenance of institutions for children are warranted, and amongst the profession there are many more "doubting Thomases." Therefore, even though we may be positive that the number of children who have tuberculosis is enormously large, and the number who show a potential possibility of becoming diseased is also very great, it will be very probable that an exceedingly minimal number will ever come to institutional care.

As a matter of fact, but few preventoria are available for the care of children. Up to within recent times all of the attention has been given to building institutions for the care of adults, and this is natural enough, since a diagnosis of tuberculosis in adult life is exceedingly easy compared with the diagnosis of the disease in childhood. It becomes necessary, then, to judge whether, in the first place, enough definite diagnoses can be made to warrant the providing of institutions for the care of children or whether it is wise, after all, to wait for a definite diagnosis but to give the advantages of institutional care to those children who may have received a probable chance of infection in family life, or who may have certain signs and symptoms which might lead one to imagine they were already infected and possibly coming to a stage of disease. However, because of the exceedingly brilliant results which can be brought forward to help statistics of institutional care and to gratify both parents and physicians, there may be a danger of emphasizing too strongly this latter point and so to fill preventoria with children who are undernourished and anemic but who really could not be said to have definite tuberculosis. It is always gratifying to effect a cure, but to treat a patient for weeks, months or years and finally to say condition merely "improved" is exceedingly dampening to one's enthusiasm. On the other hand, if

it can be proved, by any method of diagnosis at present obtainable or afterwards to be devised, that these same undernourished, weakly children are definitely tubercular, and not merely potentially so, the establishment of preventoria would certainly have justified expenditure of whatever money and time may be necessary.

The problem may be viewed, however, from a more definite basis. We are likely to give much credence to the investigation of Chadwick, of this Association, who found, in an examination of school children of Westfield, about 7 per cent. of them definitely tubercular. He does not state whether any of these have actual breaking down of the lung parenchyma but his experience has been so large as to warrant the surety that his statement of 7 per cent. is probably correct.

In my own experience in a small way with a tuberculosis clinic in Norwood—a town of some 15,000 inhabitants and a school population of 2600—I have found in the last year four children with definite pulmonary signs sufficient in extent to require treatment. Two were sent to the state sanatorium and one other application is now in and the patient is awaiting a vacancy. In the conduct of this clinic there has been but little cooperation from the district nurse so that the chances are that there are others in the town who should have come for examination. Granting, however, that four cases with definite pulmonary signs are found each year among 2600 children of school age, it is evident that there must be enough in the country at large to fill many hundreds of beds.

In Sharon, where I have been physician to the schools, I have found two children with definite pulmonary signs. This is in the proportion of two to 600—the total school population.

Of course no proportions can be very well drawn from so few cases. Still, from even this small number of well marked cases of pulmonary disease in childhood it would be within the bounds of reason to imagine that at least one child in a thousand would be found to have definite tuberculosis, that is, definite pulmonary signs as manifested by dulness and râles. Rarely would there be any sputa for examination. If we might accept this somewhat hypothetical figure as a basis of computation and if there are something like 20,000,000 school children in the country, there would be approximately 20,000 with definite pulmonary signs about whom there could be absolutely no question of diagnosis. This number would be sufficiently large to keep construction of institutions for their care going forward apace. If, in addition, all cases that might be considered fairly definitely infected were to be cared for institutionally, meaning by that not those showing symptoms of breaking down with disease but those having possibly enlarged glands, a positive tuberculin reaction, and perhaps general poor nutrition or anemia, the task would certainly be stupendous.

Up to the present time there has been but little attention given to the problem of tuberculosis in childhood, but there are indications that a solution of it is beginning to be sought. Dr. Elliott in an address given

recently in Boston drew a parallel between tuberculosis and such diseases as leprosy, malaria and yellow fever. He pointed out that we did not succeed in stamping out these diseases by treating individuals who were sick with them, but that we went at the source and eradicated the cause of these diseases. If, therefore, tuberculosis practically always starts in childhood, as we must admit it does by the evidence given us by competent observers, the way to eradicate is not by sanatorium care of adults but by preventive care in childhood.

Fortunately, many agencies have been set in operation in recent years to help this problem. For the weak, anemic and undernourished child there is the open air school. This has not been instituted as widely as it deserves. Public opinion is an inert thing, but when it becomes clear that the benefits of open air schools, or open window schools, or schools with proper and efficient ventilation are so great, there will be such a demand for these things that school committees will have to provide them. For younger children, the Grancher[6] method, of farming out those that have probably become infected in the home to families in the country, may be a means of saving many at a minimal cost. It might be doubted whether such a scheme would work in America as it has in France, because of the differences in modes of living. Still, it is well worth trying. The scout idea, with its appeal to the great love of out-of-doors, and the Health Crusader movement are tremendous helps. They doubtless have walled off many an incipient infection.

There remain, however, a tremendous number who show at some time evidence of real disease or else a condition that has been cited as "masked tuberculosis." For these sanatorium care would be indicated, as careful supervision is needed day and night. I have tried to make it evident that the number needing such care is great. Two points, however, become plainly evident,—first the paucity of accommodation that is available and second the fact that the present meager opportunities for treatment are not over crowded.

I have visited, recently, three of our new county hospitals in Massachusetts and in each one some provision had been set aside for the care of children, and in each one there were two or three children, but the beds so set aside were by no means filled.

At the Sharon Sanatorium we built a pavilion for children, which has now been in operation nearly four years, and at no time have we had it more than a third filled. Our present census shows that one quarter of the beds are taken by children who have tuberculosis and some few others are taken by those who are really beyond childhood age. It is partly because of this lack of clinical material at Sharon and in these other institutions that I considered bringing the question of sanatorium need before this Association, for certainly it is a tremendous waste of money to provide accommodation for patients who do not accept this accommodation.

We have seen that those who have spent most time in the study of potential tuberculosis in children are exceedingly enthusiastic in their consideration of the need of institutional care. Dr. Chadwick's accommodation is always taken. Farmingdale, as far as I can find out, is also filled. Dr. Jabez Elliott, of Toronto, reports that the preventorium there is crowded and there is consideration of building additions. Other places of like nature are sending similar reports. It will be noted, however, that in all these cases where all beds are taken the patient has free, or practically free care, expenses being met frequently by the city or state or by charity. At Westfield, for example, the price of board is $4.00 per week, but if the patient is poor and cannot pay this, the town from which the patient comes is obliged to foot the bill. Dr. Elliott receives certain sums from cities from which the patients come and also from the province, so that his institution is furnished something like $14 per week by these various public agencies. It is different, however, when it becomes a question of paying $15 or more per week for a child at a private institution, and I feel sure that many people who would without hesitation raise the money for an adult for a prolonged stay at a sanatorium would hesitate to spend as much for a child, not so much because they think less of the child but because the evidence of disease which requires institutional care does not appear to them so great.

Moreover, the question of family relations seems more intimate in childhood. After adolescence, the younger members of the family are expected, often, to go away to boarding school or into business, but ordinarily it seems repugnant to families to allow children to be cared for by strangers, and if such care is given for a while and the patient makes the gains in health which are ordinarily made, the length of stay is often cut short in the face of any argument from the physician. Much of the time spent is thereby lost before the matter of health can be definitely clinched.

The matter comes finally to a question of education. We must teach that the need of institutional care is pressing and that such care will give surprisingly brilliant results, not only for the immediate betterment of health of the child, but also because fewer cases of adult tuberculosis will occur if the tuberculosis of childhood is properly recognized and rightly treated. It will be necessary to educate not only the public, but the pediatricians and the profession at large, and we may rest assured that in America at least, if the need of care of tubercular children is really made evident, institutions will be forthcoming. Evidently we have made but a beginning. Apparently, also, the future fight against tuberculosis will be centered about the care of the child. Let us, then, come into that fight with all our vigor and place the treatment on the only sure, proper foundation for success, namely, at the source.

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DIAGNOSIS

By Walter L. Rathbun, M.D.

Fredonia, N. Y.

I have been connected with sanatoria where children have been treated for the past thirteen years. During the first part I was pretty sure about my diagnosis, but during the latter part I have not been so sure, and I often find myself wondering, "What is tuberculosis?" That question is very much harder to answer in a child than in an adult. This would apply particularly to the early or preminimal cases, if you might term it that way, but unfortunately, or fortunately, in one way, the far-advanced cases in children are very few in number, so that the early cases predominate. The borderline between infection and disease is very hazy and it is very often impossible to state whether you are treating infection or a child with actual disease. In these cases, the histories and symptoms are our sheet anchors, although the x-ray helps. I might add that the situation is complicated to a certain extent by the number of non-tuberculous cases that are sent to us for treatment. They are, as a rule very much easier to diagnose than the early cases of pulmonary tuberculosis or glandular tuberculosis. The lesions are for the most part confined practically to the lower lobes entirely; there are definite physical signs and these cases have sputum, and it is always negative for tubercle bacilli.

In the indefinite cases, history of a prolonged exposure is very important, for in most cases we get a history of exposure, from one or both parents or from friends. It has been stated that tuberculous infection is almost always domestic and not scholastic, so that we almost always eliminate tubercular infection in the schools. There is a possibility of a teacher or janitor having tuberculosis and thus being the source of infection, but I should judge the infection from child to child would be very unusual because of the fact that in most cases you either get a very small bronchial gland involvement with a little involvement around the hilus or you get the spreading type; you are more likely to get the latter in a child than in the adult. These cases are seldom admitted to the sanatorium because of physical requirements.

We get the data for our histories from the parents or guardian. It is very seldom you can get a history from the children as they know very little of what you are talking about, and care less. Their idea is to please the physician as much as possible, and the history is very indefinite. We send out special blanks with questions to the parents or

visiting nurse and attending physician. Occasionally, we get a very good history.

We made a study of the symptoms in 350 consecutive cases discharged at Stony Wold, and these showed the following:

Cough	35 per cent.	(Without expectoration 31)
Fever	63 per cent.	
Malaise	37 per cent.	
Night sweats	34 per cent.	
Drowsiness	21 per cent.	
Irritability	15 per cent.	
Hemoptysis	15.4 per cent.	

At Otisville, out of the 350 cases, about 5 per cent. had hemoptysis. Seventeen per cent. of these before admission had a recurrence during treatment. I presume that some of the cases of hemoptysis were due more to nosebleed than to actual pulmonary tuberculosis. About 9.5 per cent. of our children had positive sputum on examination, and 7.7 per cent. on discharge. Children do not, as you probably know, raise well, and many times have secretion but cannot seem to raise it, but I find you can teach them to do this by putting them in the knee chest position, the same as in the case of non-tuberculous treatment. We were able to get very much better results by placing them in that position.

I think a child who has been in contact with tuberculous people, and whose physical condition is below par, with a slight cough, dry or moist, an afternoon temperature, malaise, irritability, particularly in the afternoon, is in need of sanatorium treatment. It is very hard, to be sure, but I think the results at Stony Wold warrant our sticking to our present routine. There is one thing certain, that when they go back to their homes, where they will be again subjected to infection, they are in much better condition to withstand further infection, and they know more about taking care of themselves. They learn very readily, and their knowledge sticks.

Last year our gains in children were 16½ pounds each. This routine has been uniform in New York State, and I believe that the present routine is justified by the results shown.

PHYSICAL SIGNS

By John J. Lloyd, M.D.

Rochester, N. Y.

One particular thing we want to consider are the signs. There is a difference in the signs of tuberculosis in the children and the adult. There is an impression among the general profession that signs in children are often basal in character. The profession in Rochester have the idea that a basal lesion in an adult is non-tuberculous. In children they look in the bases for the lesion. It would be very difficult for me to conceive of tuberculosis in a child that could be located from the hilus outward or downward, and that would so clearly clean up as to leave no trace at the post-mortem or on x-ray plate. The object of my talk is not supposed to be on x-ray, but I would like to speak a word on it at this time. We have been doing a great deal of work with the x-ray on the children in the dispensary, and we were impressed a good while ago with the number of children whose chests showed much more marking in the apices than you would expect to find in a normal child. Then again, we found a number of cases who showed a definite hilus enlargement. These children were watched and later on they developed a very definite apical marking such as we think is tuberculosis in an adult.

In the sanatorium we have had 235 children during the past three years, and of this number there were:

No physical signs in 110 or 47 per cent.

Signs in the bases in 83 or 35 per cent.
Signs in the upper and lower lobes in 23 or 9.8 per cent.
Signs in the apex of upper lobe in 19 or 8.1 per cent.

I do not believe the condition of these children with signs in the bases is due to tuberculosis. The other children have tuberculosis, I am pretty sure, but they have a history of exposure, and they have signs by the x-ray plate which we think mean tuberculosis, yet they have not signs in the bases. We have run across possibly a dozen children in the past two or three years who have shown a very typical apical tuberculosis. I cannot see any reason for expecting any different mode of procedure from the hilus in a child than from that in an adult. The signs are the same that we get in an adult. We had one or two children brought in with a hilus involvement and they have developed very definite apical signs; first there was marked diminution in the breath sounds and

then slight prolonged expiration with moist râles. We have one or two children who have loads of râles with absolutely no symptoms, but with that condition, I should rather expect to find active tuberculosis and the child sick.

It is interesting to note that the children show exactly the same type of picture that we see in the adult. We had nine children who had positive sputum and the post-mortems in the ones we were able to get and the x-ray plate showed physical signs exactly of the same type as in the adult. We had one child who had a negative tuberculin test; had positive sputum, and cavities in both lungs, but she was not so sick that you would expect all of her resistance to be gone. She has been in the sanatorium fifteen months, yet gives a negative reaction. The ages of these children vary from 1 to 14 years, and the interesting part to me is that (I may be looking for something and finding what I am looking for) we have been unable to get physical signs, but when we do get the physical signs and are reasonably sure, we can find no difference in the action of the bacillus in the adult from that in the child.

DISCUSSION

Dr. Bowditch stated that he had had great difficulty in being able to classify tuberculosis in children, and expressed the hope that a committee would be appointed to prepare a schema which could be followed, before the next meeting.

Dr. Bushnell emphasized the fact that in making the classification, the class of glands that stand the brunt of the disease is the first thing to be considered.

Nearly all the speakers agreed that it is almost impossible to find the same condition in children as in adults, and that rarely are definite signs found on which diagnosis can be based, in the case of a child.

Dr. Otis related some of his experiences in connection with the Dispensary Clinic in Boston, and stated that the majority of suspicious cases referred to him were suffering from malnutrition, and needed sanatorium or preventorium treatment.

Dr. Hyde told of the difficulties encountered in starting their work in Buffalo. They wanted to build for one hundred twenty, but were informed by many of the physicians and lay people that they would not be able to find forty of any type of tuberculosis. They built for one hundred twenty, and within the year had their beds filled. It has been his experience that the moving picture is the greatest asset in educating the public.

* * * * *

Informal discussion was held on the Report of the Committee on Classification, Doctors Campbell of Connecticut, Barnes, Chadwick, Crane,

Heise, Lloyd, Griffin, English, Otis, Rockhill, Clarence Hyde, and Bartlett participating.

It was resolved that the Committee be instructed to include in their report—

The Rathbun Modifications.

That pneumothorax cases be classified on admission as "advanced," and on discharge as not better than "improved."

That the words "healed lesion" be used in the definition of an apparently arrested case, instead of the expression "fibrosis with little or no moisture." "Entire lung and to the second rib on the other side" be used as a substitute for the Committee's definition of a moderately advanced case.

It was proposed that for "apparently cured," the words "health satisfactory" be substituted, but this was defeated.

It was the sense of the meeting that the Committee had not drawn too narrow a definition in their suggested classification, and proper interpretation of it would not force cases into the moderately advanced or advanced groups simply because of the x-ray findings.

SEVENTEENTH SPRING MEETING OF THE AMERICAN SANATORIUM ASSOCIATION

The seventeenth spring meeting of the American Sanatorium Association was held on May 3, 1922 at Washington, D. C.

The meeting was called to order, with Dr. Lawrason Brown, president, presiding.

The secretary reported the resignations of Dr. R. C. Kirkwood and Dr. B. E. Kneece, both of whom are no longer connected with sanatoria, and the death of Dr. W. K. Quackenbush of Ottertail County Sanatorium, Battle Lake, Minn. Total membership at time of meeting 237, sixteen members having been dropped from the roll because of non-payment of dues. Applications from the following were approved, and they were elected to membership:

Dr. Herbert L. Smith, Superintendent, Jefferson County Sanatorium, Watertown, N. Y.

Dr. A. L. Gramsch, New Jersey State Sanatorium, Glen Gardner, N. J.

Dr. S. M. Bittinger, Sanatorium, N. C.

Dr. David I. Bronfin, Superintendent, J. C. R. S. Sanatorium, Edgewater, Colo.

Dr. I. G. Pace, Medical Director, Modern Woodmen Sanatorium, Woodmen, Colo.

Dr. E. L. Strader, Superintendent, Mineral Springs Sanatorium, Cannon Falls, Minn.

Dr. C. J. Woolway, Superintendent Deerwood Sanatorium, Deerwood, Minn.

Dr. R. L. Laney, Superintendent, Lake Julia Sanatorium, Puposky, Minn.

Dr. George Waldie, Superintendent, Fair Oaks Lodge Sanatorium, Wadena, Minn.

Dr. B. C. Bernard, Superintendent, Buena Vista Sanatorium, Wabasha, Minn.

Dr. Joseph W. Peabody, Superintendent, Tuberculosis Hospital, Washington, D. C.

The report of the secretary-treasurer was accepted, the usual auditing committee appointed, and the accounts approved.

Treasurer's report for period Dec. 3, 1921, to May 3, 1922

Receipts (dues)	$188.11
Expenditures (including deficit of $99.91 from last period)	186.34
Balance on hand	$1.77

The Nominating Committee reported the nomination of Dr. Lawrason Brown, President, Saranac Lake, N. Y., Dr. Walter Rathbun, Vice-President, Fredonia, N. Y., and Dr. Edward S. McSweeny, Secretary-Treasurer, 132 East 36th Street, New York City, all of whom were unanimously elected.

Doctor Crull of Indiana brought up the matter of the American Sanatorium Association supplying an employment information and exchange service, which was referred to a committee consisting of Doctors Crull, Marriette and Klotz, to consider the matter and report at the next meeting.

The President, Dr. Lawrason Brown, delivered the following address on "The Value and Necessity of Clinical Observation in the Tuberculosis Sanatorium."

THE VALUE AND NECESSITY OF CLINICAL OBSERVATION IN THE TUBERCULOSIS SANATORIUM

By Lawrason Brown, M.D.

Saranac Lake, N. Y.

Having been more or less instrumental in the formation of this society, and almost continuously one of its officers, I hope you will bear with me while I recall for a few moments its past, and indicate briefly what the future may have in store for it.

We organized one winter morning in a room at the American Museum of Natural History by electing Dr. Bowditch our first president. The members were few, and at each meeting every one was called upon to state his views on the topic under discussion. For years we restricted our membership strictly to those who were engaged in actual sanatorium work. But as time flew by (in those days I might have said dragged on) it seemed wiser to admit to membership all those who were interested in such work, with the consequent loss of some of the intimate feeling that had existed among the members. Today we approach in size many of the larger medical societies. In fact I believe the time has now come when we should appoint a committee of reorganization to see if the society cannot be made more helpful to each of its members.

I believe we should discuss a wide range of subjects. I refer to the various broader aspects of tuberculosis as applied to its clinical side. We shall never get very far ahead unless we do. With the exception of two or three tuberculosis institutes, where except in the sanatorium can the clinical problems of pulmonary tuberculosis be studied? A few men in private practice have such unlimited energy that they can study their cases in sufficient detail to be of value. Most of us cannot. Are not those of us who are closely connected with sanatoria missing wonderful opportunities? Some months ago I was talking with a leading laboratory worker who was deploring the lack of good clinical observation among physicians. He expressed his opinion of clinical men who, without much training attempted laboratory work, in terms more ornamental than complimentary. Today is the day of the experimentalist if you wish so to limit the term in medical work.

Medicine, of course, has passed through many stages. In earliest times we can note a careful study of symptoms. Then came the age of pathology when illness was interpreted in terms of diseased tissue, and all men spent part of their energies in the post mortem room. Today,

with newer apparatus and newer methods we find pathological physiology and chemistry in the foreground. Along these lines seems to fall the path of advancement for the younger men. One university selects a good bacteriologist to be professor of medicine, another a professor of anatomy, a third and fourth physiological chemists.

I am not prepared to urge any healthy young physician to tread other paths but our lines have fallen to us in other, and possibly as far as research goes, in harder places. I have long maintained that it was more difficult to contribute one new fact to the knowledge of tuberculosis than a dozen in many other medical fields. How many of the great foundations are devoting much of their funds to such study. Few indeed. The results are too meagre.

As I have said, we have in our sanatoria a wealth of material that passes through our hands every year. All of us, I know, have at heart the interest of each individual patient that comes under our care. Unfortunately some of us have so many patients dependent upon us that in our sympathetic guidance of them we consume all our energies and have left neither time for reading nor leisure for thought. It is trite to state that what we get in this life we must pay for. He who wishes to do good work in pulmonary tuberculosis must be willing to devote much time to study and thought. I have heard it said that only after five years of study can a man begin to feel orientated in tuberculosis. An institution, so understaffed that all the medical men can do is to keep their heads above the waters of routine work that ever threaten to overwhelm them, not only works an injustice to the medical workers but deprives the patients within its walls of much that might be of inestimable help to them. Let us never forget that a well ordered leisure often begets originality.

On the other hand I know of some good medical men so engrossed in their routine that instead of being a disciplined helper it becomes a stern taskmaster which brooks no such rival as investigation. It was with this idea in mind that a committee of this association was formed some years ago to determine how much routine should be demanded in institutions with small staffs. Only a man with herculean strength can be expected to slave over routine all day, and study and think half the night. How can such a thing be expected of us who all have patches on our boilers which, if we get up too much pressure, may blow off.

To study a man needs books, good books carefully selected. For this reason a list of books for a modest working library was sent to all the members of the association several years ago. To expect the poorly paid sanatorium workers to collect such a library is preposterous. The institution should provide it and should make the room where it is housed attractive and furnished with comfortable chairs. Every inducement should be offered for study. The library should contain whenever possible the journals on tuberculosis, several magazines on general medicine, a good review journal on physiology, and reviews of general

medicine as well as of tuberculosis. The *International Medical and Surgical Review* published by the American Institute of Medicine, Inc. covers most of the general ground in an eminently satisfactory manner, and the AMERICAN REVIEW OF TUBERCULOSIS, so ably edited by Dr. Krause, will keep every one abreast of what is written on tuberculosis.

The next point that I would like to discuss is the problem for study. I know how hopeless it seems to the man who has felt the urge to do good work, and on looking around all he sees is either fully tilled land or a boundless and trackless sea. He knows not where to start. I can sympathize with him for I am often in the same position. As a matter of fact I am of the opinion that it matters little on what problem a conscientious worker begins, but much on how he pursues his study of it. If I might sketch a plan for a piece of clinical work, I would suggest that the student carry with him at all hours of the day his problem. From time to time he should commit his ideas to paper and after definitely outlining the work begin upon it. His methods may be crude, and later he may have to discard months of work but he has made a beginning. After he is well started along the line he has thought out, he should lose no time, spare no energy, in looking up all the literature that bears upon the subject. His first plans stamp his work with something that is his own, with his individuality, which reading and study do not always bring. These latter however, show what other minds have thought, what other men have observed. It is of great interest to find into what broad fields a small problem leads one, to discover what new vistas, what new "leads" (as our experimentalists term them) open before us. They should note down carefully and possibly at a later date follow into far more important work. The busy clinician has no time to make careful notes which you in such work will do. Your imagination will go with you through all your duties of the day, but when it comes time for you to observe lay it aside as you do your overcoat when you enter the house. Make notes that you can swear to. If in doubt repeat the observation or question it or indeed discard it at once.

I have long felt that the logic of observation is more difficult to follow accurately than the logic of experimentation. In an experiment one must observe but as Claude Bernard says in his delightful *Introduction to Experimental Medicine,* the data to be observed are prearranged by the experimenter who more or less controls the accessory facts. We must do much of our clinical work as observers. Nature or disease arranges the data which we must observe and then divide into essential and accessory and give proper weight to each class, controlling each observation as fully as possible for otherwise it is of little value. In my opinion keen, conscientious clinical observation is rare and should be highly regarded. Accuracy outweighs numbers but accuracy and numbers cannot be gainsaid. Addison based the description of his disease on eleven carefully observed cases.

In one line of medical work observation has always held its own—I refer to diagnosis. The method of Zadig, who was the Voltairian forerunner of our modern Sherlock Holmes, created by a physician, embraces the keenest power of observation and of induction.

All men are not equally good at observation and some seem to have wonderful powers of generalization, an ability to bring together observations of others, and to induce general laws. It is curious to note how much of this has been done in England. Again others are able to present, to popularize so to speak, the medical opinions of others in such language that they seem their own. Such men are useful teachers.

To be a little more specific, many problems that need solution face us every day in our work. It is suprising how, as soon as we think we have solved some problem empirically, new work casts doubt upon our solution and demands further investigation. Take for example the ordinary sanatorium treatment, the hygienic-dietetic treatment, which all of us use daily. It would seem highly likely that by this time this treatment ought to have been established definitely by well proved facts but such is not the case. We speak of rest and exercise, of fresh air, and of good food as fundamentals in the treatment of pulmonary tuberculosis. How much do we really know about their use? Do we not keep many patients at rest too long for fear that they like many others, will walk themselves into their graves? When is the disease sufficiently arrested to enable them to begin exercise safely? What do we often say when they ask us about exercise? Begin it carefully and we shall see how you do! What is this but a confession of ignorance? We are all included in the indictment. We speak of fresh air as a *sine qua non.* How does fresh air benefit patients with pulmonary tuberculosis? How much fresh air do they need to get the greatest benefit? Is it necessary to condemn them to a continuous life of privation of all warm comforts in cold weather in order that they may recover? Do they need seven or eight hours in the fresh, cold air, and the remainder in well ventilated rooms or must they dress like Eskimos and endure as many discomforts while they live in open shacks with one heated room from which they are driven if they enter it except at prescribed and limited times?

Few of us today feel that we must stuff our patients in season and out. How much food do they really require? How much more do febrile patients need than those afebrile? Should we increase the food of patients when they begin to exercise? How much protein is required in different stages? Do certain types of food in certain quantities so affect the pulmonary ventilation that the respiration rate is raised and the healing of the lung retarded?

I have touched upon only a few of the many problems that we should endeavor to solve. Furthermore we should bring our problems and their solutions to the meetings of our association. I feel that we should extend the time of our mid-winter meeting, if not our annual meeting also, to two days.

I have hastily placed before you some thoughts that I know have passed through your minds. I have long intended to bring these ideas to a focus for free discussion and adoption or rejection, as you will, for I feel that we are now at the crossing of the ways.

In closing, let me refer once more to clinical observation which, in my opinion, has fallen from its high estate, has been dethroned by laboratory experimentation, whose devotees now sit in the high places of medicine, even of clinical medicine. Such a state of affairs is a reproach to all clinicians. Let us take as our example men who in many instances have advanced to leadership through keen clinical observation, not only of general medical subjects, but of tuberculosis as well. I refer among others to Morton, to Sydenham, to Auenbrugger, to Corvisart, to Laennec, to Bayle, to Louis, to Bowditch, to Flint, to Shattuck and to Osler, exemplars of what proficiency in clinical observation can accomplish.

Finally, let me once more urge such reorganization of our society that it will stimulate its members to observe, to record, and to bring before us twice a year the results of such work that will not only stimulate us all to further effort but make us feel proud of belonging to a society where such work is presented.

REPORT OF THE SANATORIUM FOLLOW-UP STUDY OF THE NATIONAL TUBERCULOSIS ASSOCIATION

By J. S. Whitney

New York

I wish briefly to put before you this morning the results of the sanatorium follow-up work which was launched just about a year ago.

At that time the National Tuberculosis Association, with your expressed cooperation, sent a circular letter to every sanatorium in the United States, numbering approximately 700, asking each one to cooperate with us in this study. About 110 replied saying that they would be able to cooperate with us, but those that finally did do so numbered only 56.

I shall give you a little later, the results of the data collected from these cooperating sanatoria, but first I wish to impress upon you the meagerness of this first year's study. The 56 sanatoria comprise 8500 beds, which is about 14 per cent. of the total number of beds for the tuberculous in the United States, approximately 61,000. In our study there were 12 state sanatoria cooperating, 20 county sanatoria, 6 municipal sanatoria, 5 strictly private intitutions, and 13 endowed or semi-philanthropic. The 56 sanatoria comprise approximately 8 per cent. of all the sanatoria in the country. However, out of the 56 sanatoria there were only 43 which gave us complete information including sanatorium histories, as well as follow-up cards so that the figures quoted are based on the data from 43 sanatoria, a little over 6 per cent. of all sanatoria in the country.

As you will readily see, the response to our request for cooperation has not been very general. If we have figures only on 6 per cent. of the sanatoria, the results of those figures cannot be very conclusive. As one sanatorium which is cooperating with us said in the follow-up letters sent to its former patients, "We are cooperating with the National Tuberculosis Association in a study to prove to the people of the United States the value of our sanatorium and others like it. The only way in which we can prove our claim is through your cooperation etc." I think this statement is very seriously true. Except in sporadic cases, no attempt has been made on the part of the sanatoria to check up on their results, and thereby justify not only their existence, but their future. It would seem that in the present stage of anti-tuberculosis effort it is vital for the advocates of sanatorium treatment to be able to justify the faith that

is in them. How else can this be done except by a statement of results? How can a statement of results be given when only 6 per cent. of the sanatoria attempt to do follow-up work?

While our results which we are presenting to you today are meager, nevertheless, the task of putting even these few data into shape to present to you has involved an enormous amount of work. It has necessitated the addition of an extra member to the staff, and with the printing, clerical and stenographic work, tabulation, etc., has cost the National Association already considerably over $3,000.

Is it worth while? Shall we continue this study?

Twenty of the 43 sanatoria were able to keep track of more than 50 per cent. of their patients, while 23 sanatoria, or 54 per cent., received replies from less than half of their ex-patients. These results are very inconclusive. We cannot even assume that the sample here presented is representative of the group.

The chief difficulty seems to have been, in all cases, lack of clerical help in the sanatorium offices. Many of the sanatoria have gone to considerable trouble to do this, while others have done it only half-heartedly, or not at all.

It was decided early in the study that the question of ex-service men who were under contract in the hospitals should not be included in the study of those particular hospitals, but that the whole question of the ex-service man should be handled through the War Risk Insurance Bureau. Since that time, as you know, the supervision has been transferred to the new Veterans' Bureau, which has written us that it could not possibly cooperate in this respect, so that the problem of the ex-service man is entirely eliminated in this study except as they may be patients like any other civilian. With these preliminary remarks then, the results of our findings are as follows:

Five thousand five hundred and eighty-six (5586) sanatorium histories of patients discharged in 1920 were sent us by the 43 sanatoria. Of this number, 3127, or 56 per cent. made no return, leaving 2459, or 44 per cent. for whom information was available. Six hundred and forty-three, (643) or 26 per cent. of those followed-up were known to have died subsequent to discharge, and 1816, or 74 per cent. are known to be living. Of those known to be living, one half were at work at the end of the first year after discharge from the sanatorium; three quarters of them at full time; one fourth at part time work and one half were not working, most of them because they were unable to work, but a few who said they were able to work but not able to get a job. There were a few of those who were known to be alive, for whom this information was lacking.

As regards the health of the known living, we made several rough classifications. There were 389, or 21 per cent. for whom no information in regard to health was given. Of the remainder, 647, or about 45 per cent. claimed to have had no reactivation of tuberculosis. Eleven per cent. were again in sanatoria at the end of their first year; 24 per cent. had been

sick with tuberculosis the greater part of the year, and 19 per cent. had had occasional relapses, but were able to work for the most part.

To recapitulate then, at the end of the first year after discharge, of those followed-up, 26 per cent. were dead, 74 per cent. were living. Of the living, 45 per cent. were living and well, 35 per cent. were sick with tuberculosis and 19 per cent. had occasional relapses.

I am here to put up the question to you whether we shall continue the study or not. You are the ones upon whom we must depend to give us the information, and you are the ones who will profit by the results of the study. We have already spent more than we can afford, and the results are not at all conclusive. Of course no one would expect that at the end of the first year they would be, but if there is enough interest in this study so that you will wish it continued for another year, or perhaps another two years until we do get conclusive figures, we shall be glad to do it. But I think at this time you should take some sort of definite action in regard to it so that we may know where we stand.

There are many serious obstacles in the way of making a study like this a success. There is lack of funds and clerical help in the sanatorium offices themselves. There is lack of interest on the part of ex-patients in returning the cards. There is lack of facilities in getting complete returns from patients, all of which I appreciate fully. However, if the thing is to be made a success, those obstacles must be overcome, in some way, and how, each sanatorium must decide for itself.

In a recent questionnaire sent out by the National Association in regard to the kind of follow-up method used by each sanatorium, we received 113 replies. Most of them showed that the follow-up letter, with an enclosed card for return, was the most general method, and probably the most feasible one for most sanatoria. However, there are facilities in many states in the way of clinics, county nurses, city nurses, etc., which might be utilized in order to get as complete returns as possible. Most of the sanatoria that were not taking advantage of these facilities felt that it would be possible to utilize them.

Sanatorium treatment in this study is on trial. The evidence presented to you today certainly would not acquit the defendant if that were all the evidence that could be adduced.

Shall we let it go at this, or shall we attempt to put on a more thorough study in the coming years? That is the matter upon which the National Tuberculosis Association would ask enlightenment from you today.

General discussion proceeded, and the President appointed a committee consisting of Dr. Fred Heise of Trudeau, N. Y., Dr. F. M. Pottenger of California, and Dr. E. B. Pierce of Michigan, to take this matter up and cooperate with the National Tuberculosis Association.

On motion of Dr. Waters, a committee, consisting of Doctors Waters, Barnes, and McSweeny, was appointed to consider the matter of reorgani-

zation of the Association touched upon by the President in his address, the committee to report at the next meeting.

Invitations were extended to the Association to hold its mid-winter meeting at various sanatoria, which were referred to the executive committee for action. Motion was passed that the mid-winter meeting occupy at least two days.

The regular program was then proceeded with, the first matter being the final report of the Committee and action by the Association on the Inclusion of X-ray Findings in the Classification. Dr. J. Burns Amberson, Jr., Chairman of the Committee, prefaced the presentation of the report by reading extracts from letters received from a large number of sanatorium superintendents. They concerned themselves largely with the same points which were raised at the December meeting. With the modifications as indicated herewith, on motion, the report was unanimously adopted.

AMERICAN SANATORIUM ASSOCIATION'S CLASSIFICATION OF PULMONARY TUBERCULOSIS

Modified to Include Roentgen Ray Findings and Adopted at the Seventeenth Spring Meeting, Washington, D. C., May 3, 1922.

Prefatory Note

The first action taken by the American Sanatorium Association on the classification of pulmonary tuberculosis was in 1909 when a committee was appointed to consider the advisability of revising and amplifying the scheme adopted by the National Tuberculosis Association (then The National Association for the Study and Prevention of Tuberculosis), May 18, 1905. This committee studied not only classification but also standards of examination and statistical tabulation of sanatorium cases; the complete report as adopted was published under the joint authorship of the committee which was composed of H. L. Barnes, Lawrason Brown, H. S. Goodall, Estes Nichols and L. Rosenberg (J. Am. Med. Assn., September 25, 1909, liii, 1053-6). In 1912 the same committee with the addition of H. M. King recommended a further slight revision that was adopted. Prompted by this action the National Association appointed a committee of seven to consider the wisdom of making changes; the report of this committee was approved in 1913 and the classification as drafted at that time stands today as the official scheme of the National Tuberculosis Association.

In December, 1916, the American Sanatorium Association, acting on the recommendation of a committee composed of W. L. Rathbun, Lawrason Brown and Elliott Washburn, adopted a rearrangement of the classification. This retained the text of the 1913 classification of the National Association but provided for the grouping of anatomic findings and symptoms under different headings; it was published as a committee report sent to members of the Association, August 15, 1916, and also in Rathbun's article in the American Review of Tuberculosis, 1917, i, 1.

It should be noted that this classification, as finally adopted, differs slightly from the form in which it was originally suggested by Dr. Rathbun and printed in the Transactions of the National Association for 1916 (page 432). The numerical grouping (Stage I, Stage II, Stage III) was omitted and the text was slightly altered by the committee named in the preceding paragraph. The classification, as adopted, was never published in the Transactions, but only in the places mentioned above.

At its sixteenth midwinter meeting at Rochester in December, 1920,

the American Sanatorium Association voted to consider the matter of modifying its classification to include roentgen ray findings and the undersigned committee was named to report later with recommendations. Such a modification was drafted and a preliminary report was made at the next spring meeting in New York, when it was decided to give the scheme a practical trial for a year. At this and at the seventeenth midwinter meeting the subject was discussed at some length. Members of the Association were also solicited by letter for suggestions and criticisms arising in the application of the scheme.

The scheme as outlined below is recommended, therefore, as the official classification of the American Sanatorium Association, and, as such, must be distinguished from the existing classification of the National Tuberculosis Association.

(Signed) J. Burns Amberson, Jr., *Chairman*,
Loomis, N. Y.

Charles S. Rockhill,
Cincinnati, O.

A. B. Craddock, Raybrook, N. Y.

SCHEMA FOR THE CLASSIFICATION OF PATIENTS ON EXAMINATION

Lesion	Symptoms
Minimal: (Incipient): Slight lesion limited to a small part of one or both lungs. No serious tuberculous complications.	*A (Slight or none):* Slight or no constitutional symptoms including particularly gastric or intestinal disturbance or rapid loss of weight; slight or no elevation of temperature or acceleration of pulse at any time during the twenty-four hours. Expectoration usually small in amount or absent. Tubercle bacilli may be present or absent.
Moderately Advanced: A lesion of one or both lungs, more widely distributed than under *Minimal,* the extent of which may vary, according to the severity of the disease, from the equivalent of one-third the volume of one lung to the equivalent of the volume of an entire lung with little or no evidence of cavity formation. No serious tuberculous complications.	*B (Moderate):* No marked impairment of function, either local or constitutional.

Lesion	Symptoms
Far Advanced: A lesion more extensive than under *Moderately Advanced.* Or definite evidence of marked cavity formation. Or serious tuberculous complications.	*C (Severe):* Marked impairment of function, local or constitutional.

SCHEMA FOR THE CLASSIFICATION OF SUBSEQUENT OBSERVATIONS

Apparently Cured.—All constitutional symptoms and expectoration with bacilli absent for a period of two years under ordinary conditions of life.

Arrested.—All constitutional symptoms and expectoration with bacilli absent for a period of six months; the physical signs to be those of a healed lesion; roentgen findings to be compatible with the physical signs.

Apparently Arrested.—All constitutional symptoms and expectoration with bacilli absent for a period of three months; the physical signs to be those of a healed lesion; roentgen findings to be compatible with the physical signs.

Quiescent.—Absence of all constitutional symptoms; expectoration and bacilli may or may not be present; physical signs and roentgen findings to be those of a stationary or retrogressive lesion; the foregoing conditions to have existed for at least two months.

Improved.—Constitutional symptoms lessened or entirely absent; cough and expectoration with bacilli usually present; physical signs and roentgen findings to be those of a stationary or retrogressive lesion.

Unimproved.—Essential symptoms unabated or increased; physical signs and roentgen findings to be those of an active or progressive lesion.

Died.

SPECIAL PROVISIONS AND DEFINITION OF TERMS

It is expected that all sanatoria or others using this classification will specify in their reports whether or not roentgen ray pictures have been used.

Physical signs and roentgen findings are often at variance and a given lesion should be classified by the method revealing the greater extent or intensity. For the convenience of those who want to specify in each case the basis of classification the following optional scheme of symbols is provided: When roentgen findings or physical signs are the basis of the classification, the letter (R) or the letter (P) may be written, respectively, after the group title, as Moderately Advanced (R) or Moderately Advanced (P). When the two examinations agree the symbol (PR) may be used. If a case is classified Far Advanced solely because of the presence of a serious tuberculous complication the symbol (Comp.) may be affixed.

It should be made clear that roentgen findings may be positive where physical signs are negative or doubtful or, less frequently, that definite tuberculosis may exist without demonstrable roentgenographic change.

Pneumothorax, spontaneous or induced, is to be regarded as a serious complication and its presence places the case in the Far Advanced group. If, at the time of discharge, pneumothorax exists, the patient's condition is not to be considered as better than Improved.

This classification provides for the following groups and sub-groups:

Minimal *A*	Moderately Advanced *A*	**Far Advanced *A***
Minimal *B*	Moderately Advanced *B*	**Far Advanced *B***
Minimal *C*	Moderately Advanced *C*	Far Advanced *C*

The following definitions of roentgen findings are based on the study of stereoscopic negatives (plates or films). Fluoroscopy may be of help but, alone, is of less value.

Under Minimal

1. Slight Lesion—(a) Physical Signs—Possibly slight depression above or below the clavicle, lessened movement of the chest, narrowing of the isthus of apical resonance or restricted diaphragmatic excursion; slight or no impairment of resonance; slight or no change in quality or intensity of breath sounds, with or without some change in the rhythm (i. e., prolonged expiration); vocal resonance possibly slightly increased; râles present, absent or transitory. If sputum contains tubercle bacilli, any of these.

(b) Roentgen Findings—Roentgenograms to show lessened transmission of light in the form of poorly defined, light mottling or diffuse haziness interpreted as infiltration or conglomeration of tubercle, or more intense shadows of a well defined, stellate or fibrillar character interpreted as fibrosis, with or without opacities interpreted as calcification.

2. A Small Part of One or Both Lungs—Total volume of involvement, regardless of distribution, shall not exceed the equivalent of the volume of lung tissue which lies above the second chondro-sternal junction and the spine of the fourth or body of the fifth thoracic vertebra on one side.

Under Moderately Advanced and Far Advanced

3. Lesion Allowable under Moderately Advanced—One or both lungs may be involved but the total involvement shall not exceed the following limits:

(a) Slight disseminated infiltration or fibrosis which may extend through not more than the equivalent of the volume of one lung.

(b) Severe infiltration with or without fibrosis which may extend through not more than the equivalent of one-third the volume of one lung.

(c) Any gradation within the above limits.

(d) Total diameter of cavities, if present, should not exceed 2 cms.

4. Physical signs of Moderately Advanced Lesions are more variable than those of *Minimal* lesions and do not usually determine the exact extent of the involvement.

5. Roentgen Findings in Moderately Advanced Lesions—Roentgenograms to show shadows similar in character to those described under *Minimal* (paragraph 1-b) but more extensive or more intense, with or without areas of rarefaction interpreted as cavity formation.

6. Definite Evidence of Cavity Formation—Tubercle bacilli usually present; elastic fibers may be present in sputum. Physical signs may not be definite but a combination of any four of the following signs is to be taken as indicative of cavity formation; (1) bubbling or consonating râles; (2) cracked-pot-note; (3) amphoric breathing; (4) intense whispering pectoriloquy; (5) post-tussive suction. Roentgenograms to show single or multiple areas of rarefaction surrounded by dense borders.

7. Serious Complications—These should be limited to tuberculous complications affecting any organ tissue to such an extent as to impair seriously local function, as determined by symptoms, and influence unfavorably the prognosis of the case.

Under Symptoms

8. Slight Constitutional Symptoms—Slight impairment of digestion; slight loss of appetite, of strength, of weight; lassitude; nervousness; possibly slight acceleration of pulse and possibly slight elevation of temperature. (See definitions No. 9 and No. 10). The impairment of health may be hardly apparent objectively or subjectively.

9. Slight Elevation of Temperature—Maximum temperature after rest for one-half hour seldom over 99.5° F. by mouth, or 100.5° F. by rectum.

10. Slight Acceleration of Pulse—Maximum pulse rate seldom over 90 per minute for men and 96 per minute for women, after resting for one-half hour, sitting or lying, except when due to causes other than tuberculosis.

11. Absence of Tubercle Bacilli—Each monthly examination, if the sputum has previously been negative, to consist of careful microscopic inspection with a mechanical stage of two smears, devoting at least three minutes to each smear made from selected particles (at least six from different parts) of the sputum on each of three successive days. The morning sputum should always be obtained or, better, the minute bits that some patients raise at infrequent intervals. In case the findings are negative the total amount of sputum collected on three successive days should be concentrated and examined microscopically. Animal inoculation or cultural implantation is desirable when indicated.

12. Marked impairment of Function either Local or Constitutional—

Local—Marked dyspnea on exertion, limiting seriously the patient's activity.

Constitutional—Marked weakness, anorexia, tachycardia.

Under Apparently Cured, Arrested and Apparently Arrested

13. Constitutional Symptoms—These include elevation of temperature, loss of weight, loss of strength, night-sweats, chills, tachycardia, cyanosis, loss of appetite, amenorrhea, etc.

14. Ordinary Conditions of Life—This term as used implies that the patient is able to live in an environment where he is able to support himself without the assistance of others, or to live in his former surroundings and pursue his former occupation.

15. Physical Signs of a Healed Lesion—These may embrace every physical sign of infiltration or consolidation with the exception of râles which must be permanently absent except possibly a few fine râles at the base, probably atelectatic in origin, and at one apex or over a small part of one lung (See definition no. 2.) Fine râles in the latter two places are to be heard only during cough, at the end of a prolonged expiration, or during the inspiration which follows cough. There are no certain criteria of a healed lesion and this definition has its exceptions.

16. Apex—That portion of the lung situated above the clavicle and the third thoracic spine.

17. Roentgen Findings Compatible with Physical Signs of a Healed Lesion—Roentgenograms to show clearing, fibrosis, calcification or a stationary condition.

UNDER IMPROVED

18. Constitutional Symptoms Lessened or Entirely Absent—Improvement in general condition as shown either by gain in both weight and strength or by reduction of previous febrile temperature to normal without loss of strength.

UNDER UNIMPROVED

19. Essential Symptoms—These include, among others, loss of weight, impairment of strength and appetite, night-sweats, hemoptysis, pleurisy, dyspnea, fever, tachycardia, cough and expectoration.

AFTERNOON SESSION

The afternoon session was given up to an informal discussion of problems of tuberculosis sanatorium administration. In the absence of Dr. English, Dr. Campbell of Norwich, Connecticut, presented various topics for consideration, which had been chosen by the Committee in charge.

The first of these—"The Best Type of Nurse for the Tuberculosis Sanatorium, and How to Secure Her," brought out a very general participation and discussion. Many called attention to the fact that very little was being done in the way of training nurses in the proper care of tuberculosis cases, and that in general hospitals this was being neglected. Some few instances were noted where general hospitals had made arrangements to give tuberculosis nursing as a part of the regular training, by reciprocity arrangements with sanatoria. Emphasis was laid on the necessity of providing proper accommodations and other facilities, both professional and personal, for these pupil nurses, for the arrangement to meet with success and support. For the most part, the sanatoria would have to pledge themselves to compensate the nurses treating their cases in the institutions. Great stress was laid by many speakers on the extravagance of using all graduate nurses when the practical nurse could so often take her place, not only at a lesser cost, but also because the practical nurse can be obtained in large numbers.

The training of nurses in sanatoria met with unanimous approval. It was generally agreed that with all the disadvantages of dealing with patients, the limited field, and the difficulties as to the class of certificate which could be offered to girls taking this training, nevertheless, such training schools have met with much success in widely scattered places, and if properly conducted, should succeed anywhere.

In connection with this, The Trudeau School for Nursing has made arrangements with other hospitals to give their girls work which is not obtainable at the Sanatorium, so that State educational requirements could be complied with, and certificates of a higher grade awarded to them.

Consensus of opinion was that for routine ward work, more attention should be paid to obtaining competent girls physically able to do a reasonable amount of work, giving them sufficient instruction, and having them work under proper supervision, than attempting to conform to local or other standards designating particular qualifications. It was, however, the opinion of practically everyone that some formal course of instruction, with a certificate, maintaining as high a standard as possible, without decreasing the number of applicants, is a very essential feature of all tuberculosis nursing and training work.

Dr. Rockhill of Cincinnati has made a drive to induce the widows of patients who had died of tuberculosis to enter this field, with great success.

The second topic presented by the Committee for discussion was "Research Work as a Means of Keeping the Medical Staff Interested." This also brought out a very general response on the part of those present.

All of the speakers agreed that something more than the usual routine daily medical duties was essential if the staff were to be kept interested and zealous; that this was largely a question of enthusiasm, depending upon the leadership of the man in charge of the intitution, and not a question of extensive and elaborate building or apparatus.

Many speakers alluded to research problems and studies which had been taken up in their individual sanatoria and had interested the entire staff for over a considerable period with satisfactory results, not only in the actual information acquired, but in the effect on the professional morale of the sanatorium physicians.

The President, Dr. Brown, in talking, accentuated the necessity of clinical research as against the purely laboratory phase of this work, and this was discussed by several speakers.

NATIONAL TUBERCULOSIS ASSOCIATION

BY-LAWS

LIST OF MEMBERS

OCTOBER 1, 1922

BY-LAWS OF THE NATIONAL TUBERCULOSIS ASSOCIATION *

Article I — Name

The name of this Association shall be National Tuberculosis Association.

Article II — Objects

The objects of said Association are:

(a) The study of tuberculosis in all its forms and relations;

(b) The dissemination of knowledge concerning the causes, treatment and prevention of tuberculosis;

(c) The encouragement of the prevention and scientific treatment of tuberculosis;

(d) The stimulation, unification and standardization of the work of the various anti-tuberculosis agencies throughout the country, especially the state and local associations;

(e) The coöperation with all other health organizations in the coördination of health activities;

(f) The promotion of international relations in connection with health activities in the study and control of tuberculosis.

Article III — Seal

The seal of this corporation shall consist of a flat-faced circular die with the words and figures, "National Tuberculosis Association, Corporate Seal, 1918, Maine," cut or engraved thereon.

Article IV — Membership

The members of this Association shall consist of five classes: (a) Members; (b) Life Members; (c) Corporate Members; (d) Representative Members; (e) Honorary Members.

(a) The persons who made application, dated September 6, 1918, for the incorporation of this corporation shall be members without payment

* Adopted at the meeting of the Board of Directors held March 11, 1921.

of dues until the annual meeting of the members, to be held in 1919, and all persons who are members in good standing on September 25, 1918, of the voluntary association known as NATIONAL TUBERCULOSIS ASSOCIATION as shown by the Membership Ledger of said voluntary association now in possession of the Managing Director of said voluntary association, shall be members of this corporation with dues paid up to the time to which their respective dues in said voluntary association are paid up, and such members as shall from time to time be approved by the Executive Committee shall be members of this corporation. The dues of members shall be $5.00 a year.

(b) Members may become Life Members upon the payment of $100.

(c) Anti-tuberculosis associations other than Affiliated and Represented Associations, sanatoria, dispensaries, open-air schools, and similar agencies, libraries and industrial and other corporations, may be Corporate Members, with the approval of the Executive Committee, on payment of $5.00 or more per annum.

(d) Affiliated and Represented Associations, or persons representing such associations, if unincorporated, and selected by them, may be Representative Members, with the approval of the Board of Directors, on payment of $25 or more per annum.

Associations herein designated Affiliated and Represented Associations consist of State Tuberculosis Associations and certain other local associations hereinafter specified, which have and maintain the following qualifications:

(1) They shall not be under the direction or control of any state or local governmental agency;

(2) Such associations must have:

(a) A membership which has representation and participation in its affairs.

(b) A president and other officers, an Executive Committee, a salaried executive or similar officer, and a Board of Directors representative of the territory covered by the association.

(c) The membership must meet at least once a year; the Board of Directors or Executive Committee must meet at least four times a year.

(d) The association must operate under a constitution and by-laws, with an annual program and budget.

(e) The accounts must be audited by a certified public accountant or his equivalent at least once a year, and copy filed with the National Association.

(f) An annual report of accomplishments, receipts and expenditures shall be prepared and made available to officers, members and the public, and given all possible publicity.

(g) All associations shall comply with and carry out the aims and objects of the National Association, submitting such reports as may be required by the Association, and must accept the responsibility of working out and sharing with the National Association means of financing their mutual activities.

The other associations above referred to are the following: District of Columbia Tuberculosis Association, New York Tuberculosis Association, Committee on the Prevention of Tuberculosis of the Brooklyn Bureau of Charities, Tuberculosis League of Pittsburgh, Chicago Tuberculosis Institute, and the Committee on Tuberculosis and Public Health of the State Charities Aid Association of New York.

The Board of Directors of the National Tuberculosis Association shall be the sole judge of the foregoing qualifications for Affiliated and Represented Associations, and of their right to membership and representation on the Board of Directors.

The Board of Directors, by a majority vote, may suspend the foregoing qualifications for Affiliated and Represented Associations between the period of June 13, 1921, and July 1, 1922.

(e) Persons distinguished for original researches relating to tuberculosis, or eminent as sanitarians or as philanthropists who have given material aid in the study and prevention of tuberculosis may be elected Honorary Members by the Board of Directors.

Any member failing to comply with the provisions of the By-Laws of this corporation shall thereupon cease to be a member.

Article V — Board of Directors

Section 1. The Board of Directors of this corporation shall consist of 50 members (designated herein as Directors at large), and an additional number of members (designated herein as Representative Directors), and they shall be divided into two classes of as nearly equal number as practicable. At the first annual meeting held after the adoption of these by-laws, one-half of the members, less any odd number, shall be elected for a term of one year and the other half and the odd member, if any, for a term of two years, and thereafter at each annual meeting there shall be elected for a term of two years directors equal in number to the class of Directors whose terms then expire, and for a term of one or two years, as circumstances may require, an additional number, if necessary, in order to fill all existing vacancies and to provide a Representative Director to represent each Affiliated and Represented Association, as provided in the next paragraph of this Article.

The Representative Directors shall be elected from persons nominated by the Affiliated and Represented Associations and in such manner that there shall be one and only one Representative Director for each such Affiliated and Represented Association, and there shall be in each class of Directors an equal number as near as may be of Representative Direc-

tors. Notice of such nominations shall be mailed to the executive office of the Association at least fifteen days before the meeting at which the Representative Directors are to be elected. Each person nominated by an Affiliated and Represented Association must be a member of the directorate of such association, and in the event that such Representative Director shall cease to be a member of such directorate, or his Affiliated and Represented Association shall cease to comply with the qualifications herein prescribed for such association, he shall *ipso facto* cease to be a member of the Board of Directors of this Association.

Retiring directors who have served two successive terms shall not be eligible for reëlection until one year after the year of their retirement.

At least one-third of the total number of the Directors at large shall consist of laymen. The Board of Directors may, at its discretion, fill any or all vacancies caused by death, removal, resignation, disqualification or otherwise, of any of its members for the unexpired term at a regular meeting of the Board, provided that written notice specifying the vacancies to be filled be given in hand or mailed to each member of the Board at least twenty days in advance of the meeting. Vacancies in the ranks of Representative Directors shall be filled from nominations made by the Affiliated and Represented Association in question.

On June 15, 1921, at twelve o'clock noon, the terms of office of the Board of Directors then in office shall cease and terminate and the new directors, elected as herein provided, shall assume office forthwith.

Section 2. Except as otherwise provided in these By-Laws the Board of Directors shall have entire charge and control of the business and property of the corporation, the planning of the work, the fixing of the time and place for the annual or special meetings of the members to be held in the State of Maine for the election of Directors or for any other purpose and the arrangements for congresses, legislation and all other matters pertaining to its affairs.

Section 3. The Board of Directors is empowered to appoint representatives on national or international committees or other agencies that deal with tuberculosis or public health work. It shall also from time to time appoint such committees as may be necessary for scientific, charitable and educational work and for the holding of meetings and congresses.

Section 4. Seven Directors shall constitute a quorum.

Article VI — Officers

Section 1. The officers of the corporation shall be a President, two Vice-Presidents, a Secretary, a Treasurer, a Clerk and such other officers or agents as the Board of Directors may from time to time elect. All of the officers of the corporation, with the exception of the Clerk, shall be elected annually by the Board of Directors. The Directors and the Clerk shall be elected annually by the members. The President must be a mem-

ber of the Board of Directors. The other officers may be, but need not be, members of such Board.

SECTION 2. All officers shall perform the duties commonly incident to their respective offices, and shall perform such other duties and have such other powers as are prescribed by these By-Laws or as the Board of Directors or the Executive Committee shall from time to time designate.

The Secretary, or in his absence a secretary *pro tempore* shall keep correct minutes of all meetings of the Board of Directors and of the Executive Committee.

The Clerk, or in his absence a clerk *pro tempore* shall keep correct minutes of all meetings of the members.

The Clerk or clerk *pro tempore* shall be sworn to the faithful performance of his duties.

ARTICLE VII — EXECUTIVE COMMITTEE

There shall be an Executive Committee, composed of the President and Vice-Presidents, Treasurer and Secretary ex officio and seven members of the Board—the latter to be elected annually by the Board, which Committee shall exercise all the powers of the Board of Directors when the Board is not in session and such powers as are conferred by these By-Laws, subject to the approval of the Board.

ARTICLE VIII — MEETINGS

SECTION 1. *Meetings of Members.* A meeting of the Members of the corporation shall be held annually at the office of the corporation in Portland, Maine, at such time as may be fixed by the Board of Directors or by the Executive Committee. Special meetings of the Members shall be held at said office of the corporation when so ordered by the Board of Directors. Notice of the time and place of all meetings of the Members, and in the case of special meetings of the business to be transacted, shall be published by the Clerk once, at least seven days* before the meeting, in some newspaper published in Portland, Maine. Each Member, Life Member, Corporate Member and Representative Member shall be entitled to one vote. Members and Life Members may vote at meetings either in person or by written proxy. Corporate members may vote by their duly authorized representatives or such representatives' proxy in writing. Ten members entitled to vote, present either in person or by proxy, shall constitute a quorum.

SECTION 2. *Meetings of the Board of Directors.* Regular meetings of the Board of Directors shall be held in such places and at such times as the Board may by vote from time to time determine; and if so determined, no notice thereof need be given. Special meetings of the Board of Directors may be held at any time or place whenever called by the

* As amended November 14, 1918.

President, reasonable notice thereof being given to each Director, or at any time without formal notice, provided all the Directors are present, or those not present have waived notice thereof in writing. Such special meetings shall be held at such times and places as the notice thereof or waiver shall specify.

SECTION 3. *Meetings of the Executive Committee.* The Executive Committee shall hold meetings when called by the President.

ARTICLE IX — MONEYS

Moneys received from membership dues and from all other sources shall be used for defraying the expenses of the corporation and furthering its objects under the direction of the Board of Directors. The Treasurer shall keep proper accounts of all receipts and disbursements, which accounts shall be subject to the supervision of the Board of Directors.

ARTICLE X — AMENDMENT OF BY-LAWS

These By-Laws may be altered, amended or repealed by a two-thirds vote of the members of the Board of Directors present at a meeting of the Board, provided that the proposition to amend has been presented in writing at a previous meeting of the Board and that subsequent to such presentation twenty days' notice in writing has been given of the proposed amendment in the call for the meeting.

GEOGRAPHICAL LIST OF MEMBERS

LIFE MEMBERS

Barrel, Finley, Chicago
Blumenthal, George, New York
Clark, F. A., New York
Fisk, Harvey Edward, New York
Harkness, Edward S., New York
Harris, Emma Gale, Chicago
Higginson, Henry L., Boston
Knickerbacker, Mrs. H., New York
Knopf, Dr. S. Adolphus, New York
Larson, Ejnar, Wayne, Neb.
Lewisohn, Adolph, New York
McCormick, Cyrus H., Chicago
Macy, V. Everit, New York
Maloney, Martin, Philadelphia
Marshall, Louis, New York
Mather, Samuel, Cleveland
May, Francis E., Chicago
Phipps, Henry, New York
Platt, Henry B., New York
Rockefeller, John D., New York
Swift, L. F., Chicago
Wanamaker, Rodman, Philadelphia
Warburg, Felix M., New York
Waring, Mrs. James J., Denver

CONTRIBUTORS

Alden, George I.
Alling, Mrs. Joseph T.
Allis, Louis
Auchincloss, John W.
Behrend, Miss Mary
Bliss, Miss Lizzie
Boone, A. U.
Cambridge Anti-Tuberculosis Society
Emerson, Mr. and Mrs. William
Employees Standard Varnish Works
Herschel, Mr. and Mrs. A. H.
Leupp, Mrs. F. E.
Lewis, Howard W.
Jones, Mrs. Jane B.
Mallinckrodt, Edward
Parmentier, Mrs. Douglas
Patten, Mrs. G. S.
Rathbone, Mrs. Mary E.
Sanborn Company
Stromberg, Mrs. Gustaf
Tod, Mrs. J. Kennedy
Vonnegut, Franklin

GEOGRAPHICAL LIST OF THE MEMBERS OF THE NATIONAL TUBERCULOSIS ASSOCIATION OCTOBER 1, 1922

ALABAMA

Alabama Tuberculosis Association, Mrs. H. E. Pearce, Representative Member, Birmingham
Calhoun County Anti-Tuberculosis League, Anniston
Carter, Dr. H. R., Jr., Birmingham
Eaves, Rev. George, D.D., Birmingham
Fairbairn, C. T., Birmingham
Lewis, Dr. T. K., Birmingham
Lull, Dr. Cabot, Birmingham
Montgomery Anti-Tuberculosis League, Montgomery
Munger, R. S., Birmingham
Price, Bem, Birmingham
Welch, Dr. S. W., Montgomery

ARGENTINA

Noreau, Dr. Alicia, Buenos Aires

ARIZONA

Arizona Anti-Tuberculosis Association, Dr. John W. Flinn, Representative Member, Phoenix
Babbit, David, Flagstaff
Brown, Dr. O. H., Phoenix
Cohen, Dr. M. D., Tucson
Cuvellier, T. C., Phoenix
Evans, Mrs. H. D., Mesa
Fahlen, Dr. Frederick T., Phoenix
Fischer, George A., Phoenix
Flinn, Dr. John W., Prescott
Fredericks, R. N., Prescott
Greulich, Dr. W. W., Prescott
Hazeltine, M. B., Prescott
Holmes, Dr. Fred G., Phoenix
Keeney, Dr. Madison J., Phoenix
Laben, Dr. George, Supai
Metzger, Dr. Jeremiah, Tucson
Miller, Dr. Frederick, Miami
Mills, Dr. Charles W., Tucson
Oliver, Dr. L. H., Prescott
Phillips, Dr. E. W., Phoenix
Phoenix Sanatorium, Phoenix
Pollock, T. E., Flagstaff
Pollock, Mrs. T. E., Flagstaff
Randolph, Col. Epes, Tucson
Thomas, Dr. C. A., Tucson
Walton, William, Palo Verde
Watson, Dr. Samuel H., Tucson
Wilson, Dr. A. D., Prescott

ARKANSAS

Abeles, Charles T., Little Rock
Arkansas Tuberculosis Association, Little Rock
Billingsley, Mrs. W. A., Newport
Cooper Clinic, Fort Smith
Grand Lodge A. O. U. W. of Arkansas, Little Rock
Hayes, C. E., Little Rock
Jefferson County Tuberculosis Association, Pine Bluff
Shipp, Dr. A. C., Little Rock
Tarkington, Dr. G. E., Hot Springs
Terry, Mrs. D. D., Little Rock
Williams, Hamp, Hot Springs

AUSTRALIA

Lanza, Dr. A. J., Melbourne

BRAZIL

Souza, Dr. Geraldo H., Sao Paulo

CALIFORNIA

ALAMEDA COUNTY SOCIETY FOR THE STUDY AND PREVENTION OF TUBERCULOSIS, Oakland
ANDERSON, DR. JENNIE, San Francisco
ANDERSON, DR. OSCAR, Santa Monica
ATKINSON, DR. CHARLES E., Banning
AXELROD, DR. A., Monrovia
AYER, HAROLD O., Pasadena
BAGG, DR. C. P., Los Angeles
BARLOW, DR. W. JARVIS, Los Angeles
BECKETT, DR. W. W., Los Angeles
BERRES, MISS DORA, Los Angeles
BINE, DR. RENE, San Francisco
BOYD, DR. WALTER M., Los Angeles
BREM, DR. WALTER V., Los Angeles
BRODE, MISS ARLETTA E., Los Angeles
BROOKS, DR. STEPHEN D., Los Angeles
BROWN, DR. PHILLIP KING, San Francisco
BROWNING, DR. CHARLES C., Los Angeles
BRUST, MRS. S. M. B., San Diego
BURGAN, DR. JAMES H., Los Angeles
BURNSIDE, DR. CHARLES, Los Angeles
BURR, DR. RUTH, Livermore
BUSH, DR. CHESLEY, Livermore
CALIFORNIA TUBERCULOSIS ASSOCIATION, Dr. Robert A. Peers, Representative Member, Fresno
CHAIN, DR. JOHN N., Eureka
CHANDLER, DR. JAMES J., Soldiers' Home
CITY HOME LEAGUE, Riverside
CLARK, DR. W. R. P., San Francisco
COBB, DR. C. E., Sawtelle
COHN, DR. HARRY, Camp Kearney
CONN, DR. CAROLINE, Palo Alto
CONN, DR. WALTER SCOTT, Palo Alto
COOK, DR. JOSEPH W., Banning
*COX, DR. THOMAS J., Sacramento
CRAVENS, JOHN S., Los Angeles
CROCKER, WILLIAM H., San Francisco
CUNNINGHAM, DR. R. L., Los Angeles
DIBBLIE, MRS. BENJAMIN, Ross
DICKSON, DR. C. B., Los Angeles
DONEHOO, MAJOR W. S., Camp Kearney
DUNHAM, DR. R. W., Soldiers' Home
DURAND, DR. CHARLES J., Colfax
EATON, DR. H. DOUGLASS, Los Angeles
ELLIOTT, J. M., Los Angeles
EVANS, DR. GEORGE H., San Francisco
EVANS, DR. NEWTON, Loma Linda
FLY, DR. EDWARD M., National City
FORD, TOD, Pasadena
FORD, MRS. TOD, Pasadena
FOWLER, MRS. ELDRIDGE M., Chino
FRANK, MRS. A., Long Beach
FULLERTON, MISS KATHERINE, Pasadena
GOSNEY, E. S., Pasadena
GRIFFITH, MISS ALICE S., San Francisco
HACKETT, MRS. HELEN M., La Vina
HALSTEAD, S. HAZARD, La Vina
HAND, FRANK E., Los Angeles
HASHIBA, DR. G. K., Fresno
HAYES, DR. E. W., Monrovia
HAYNES, DR. JOHN R., Los Angeles
HENDRY, GEORGE W., San Francisco
HEWLETT, DR. ALBION W., San Francisco
HOIT, DR. HENRY, La Vina
HOLLERAN, DR. WALTER M., Los Angeles
HOLTERHOFF, G., JR., Los Angeles
HOOKER, MRS. KATHERINE, San Francisco
HOWARD, DR. BURT E., Sacramento
HOWARD, MRS. MARGARET K., La Vina
HOWSON, DR. C. R., Los Angeles
JOHNSON, REGINALD, Pasadena
JOHNSON, MRS. REGINALD, Pasadena
JONES, MRS. EVERETT, Alameda
KALB, DR. GEORGE B., Monrovia
KENT, HON. WILLIAM, Kentfield
KING, DR. ERNEST HAROLD, La Vina
KIRSCHNER, DR. H. EDWARD, Monrovia
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LEUPP, MRS. FRANCIS E., Pasadena
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LONG BEACH SOCIAL WELFARE LEAGUE, Long Beach
LOS ANGELES COUNTY HOSPITAL, Los Angeles
LOS ANGELES TUBERCULOSIS ASSOCIATION, Los Angeles
LUCKIE, DR. J. B., Pasadena
MCGINNIS, DR. G. H., San Diego
MCKENNEY, DR. J. A., Parlier
MCKEON, DR. F. H., Camp Kearney
MACKERRAS, DR. R. H., Pasadena
MANWARING, DR. WILFRED H., Stanford University
MATTISON, DR. F. C. E., Pasadena
METCALF, DR. JULIA T., Los Angeles
MITCHELL, DR. ROBERT, Sierra Madre
MONTEREY COUNTY TUBERCULOSIS ASSOCIATION, Salinas
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MORRISON, DR. M. M., Camp Kearney
NEILSON, DR. JOHN C. E., San Diego
NEVIUS, DR. JOHN W., Los Angeles
OLIVE VIEW SANATORIUM, San Fernando
ONTARIO-UPLAND ASSOCIATION FOR STUDY AND PREVENTION OF TUBERCULOSIS, Ontario
OPHULS, DR. WILLIAM, San Francisco
PACIFIC MUTUAL LIFE INSURANCE CO., Los Angeles
PASADENA TUBERCULOSIS ASSOCIATION, Pasadena
PEERS, DR. ROBERT A., Colfax
PENOYER, MRS. C. W., Burlingame
PERRY, J. C., San Francisco
PIERSON, DR. PHILIP K., San Francisco
PIKE, ROBERT D., San Rafael

* Deceased

Pottenger, Dr. F. M., Monrovia
Pottenger, Dr. J. E., Monrovia
Remington, Dr. Lewis D., Monrovia
Robinson, Henry M., Pasadena
Robinson, Major L. S. B., San Diego
R. R. Rogers Chemical Company, San Francisco
Rosencrantz, Dr. Esther, San Francisco
Rothschild, Dr. Max, San Francisco
Sacramento County Tuberculosis Association, Sacramento
Sanders, Dr. Audley O., Menlo Park
San Diego Tuberculosis Association, San Diego
San Francisco County Medical Society, San Francisco
San Francisco Tuberculosis Association, San Francisco
San Joaquin County Red Cross, Stockton
Scheier, Dr. Ralph B., San Francisco
Scripps, Miss E. B., La Jolla
Schafer, Dr. E. A., Keene
Shank, Dr. G. A., Huntington Beach
Sherman, Dr. Harry M., San Francisco
Shipman, Dr. Sidney J., Colfax
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Smith, Dr. Harvey, Los Angeles
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Stanley, Dr. Leo, San Quentin
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von Adelung, Dr. E., Oakland
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Visiting Nurse Association, Monrovia
Visscher, Dr. L. G., Los Angeles
Voorsanger, Dr. William C., Los Gatos
Warren, Dr. H. C., Belmont
Weaver, Dr. A. Carlton, Los Angeles
Weber, Dr. A. L., Cucamonga
Weimar Joint Sanatorium, Weimar
Welfare and Public Health Service, San Mateo
Wheate, Dr. Justus M., Palo Alto
Wheeler, Mrs. R. A. S., Pasadena
Williams, Dr. Allen H., Santa Barbara

CANADA

Adamson, Dr. J. D., Winnipeg, Man.
Anglin, Dr. George C., Toronto, Ont.
Archibald, Dr. Edward, Montreal, Que.
Baillie, Dr. D. M., Victoria, B. C.
Baker, Dr. A. R., Calgary, Alta.
Bayliss, J. J., Hamilton, Ont.
Bayne, Dr. C. M., Kentville, N. S.
Boughton, Dr. Harvey C., Ft. Qu'Appelle, Sask.
Brink, Dr. G. C., Burlington, Ont.
Broome, Dr. A. E., London, Ont.
Busby, Dr. E. M., Montreal, Que.
Byers, Dr. J. Roddick, St. Agathe des Monts, Que.
Carmichael, Dr. D. A., River Glade, N. B.
Caulfield, Dr. A. H. W., Toronto, Ont.
Cholette, Dr. A. M., Montreal, Que.
Cook, Dr. A. B., Regina, Sask.
Couillard, Dr. J. A., Quebec, Que.
Coutts, Dr. E. N., Freeport, Ont.
Day, Dr. J. G., Sanatorium, P. O., Ont.
Dobbie, Dr. W. J., Weston, Ont.
Dube, J. E., Montreal, Que.
Dube, Dr. L. F., Quebec, Que.
Elliott, Dr. J. H., Toronto, Ont.
Farris, Dr. H. A., E. St. John, N. B.
Ferguson, Dr. Duncan D., London, Ont.
Flock, Dr. G. Murray, Windsor, Ont.
Garrison, Dr. W. Miles, Charlottetown, P. E. I.
Gordon, Dr. J. K. M., Ottawa, Ont.
Grenier, Dr. Eugene, Montreal, Que.
Guibault, Guy, Joliette, Que.
Hart, Dr. William M., Ottawa, Ont.
Hastings, Dr. Charles J., Toronto, Ont.
Hattie, Dr. W. H., Halifax, N. S.
Holbrook, Dr. J. H., Hamilton, Ont.
Hopkins, Dr. Bruce M., Kingston, Ont.
Houle, Dr. L. G., Kamloops, B. C.
Irving, Dr. R. W., Kamloops, B. C.
Jarry, Dr. J. Arthur, Montreal, Que.
Jenssen, Mrs. Darre, Montreal, Que.
Kendall, Dr. W. B., Gravenhurst, Ont.
King, Dr. MacDougall D., Bala, Ont.
Kinsey, Dr. H. I., Toronto, Ont.
Kirkby, Dr. R. W., Fort Qu'Appelle, Sask.
MacKay, Dr. William M., Kingston, Ont.
McGibbon, Dr. D. Lorne, Montreal, Que.
Miller, Dr. Arthur Frederick, Kentville, N. S.
Minns, Dr. Frederick S., Toronto, Ont.
Morris, Dr. William, Vancouver, B. C.
Mountain Sanatorium, Hamilton, Ont.
Moyle, Dr. R. D., London, Ont.
Mullin, Dr. R. H., Vancouver, B. C.
Murphy, Dr. H. H., Kamloops, B. C.
Neal, Dr. Frank C., Peterborough, Ont.
Norman, Dr. T. J., Edmonton, Alta.
Ogden, Dr. W. E., Toronto, Ont.
Parfitt, Dr. Charles D., Gravenhurst, Ont.
Porter, Dr. George D., Toronto, Ont.

Pratten, Dr. F. H., London, Ont.
Ross, Dr. C. B., Gravenhurst, Ont.
Royer, Dr. B. Franklin, Halifax, N. S.
Segal, Dr. Jacob, Montreal, Que.
Seymour, Dr. M. M., Regina, Sask.
Sieniewiez, T. M., Kentville, N. S.
Smith, W. S., Pilot Mound, Man.
Stables, Miss Edith F. W., Kingston, Ont.
Stewart, Dr. David A., Ninette, Man.
The Tranquillian, Tranquille, B. C.
Tovell, Dr. H. M., Toronto, Ont.
Verschelden, Dr. Louis, Montreal, Que.
Vidal, Dr. J. A., Montreal, Que.
Vrooman, Dr. C. H., Vancouver, B. C.
Walker, Dr. T. W., Saskatoon, Sask.
Welwood, Dr. T. R., Toronto, Ont.
Wilson, Dr. Arthur, Saskatoon, Sask.
Wodehouse, Dr. R. E., Ottawa, Ont.
Wyatt, Dr. Bernard L., Grand Mere, Que.

CHINA

Selmon, Dr. A. C., Shanghai
Grant, Dr. John B., Peking

COLORADO

Amesse, Dr. John William, Denver
Apperson, Dr. Edwin L., Denver
Arneill, Dr. James R., Denver
Beggs, Dr. William N., Denver
Berger, George B., Denver
Berger, William N., Jr., Denver
Berger, Mrs. William N., Jr., Denver
Bergtold, Dr. William H., Denver
Bonney, Dr. S. G., Denver
Bortree, Dr. Leo W., Colorado Springs
Bronfin, Dr. I. D., Edgewater
Brown, Dr. L. G., Colorado Springs
Burnett, Dr. Clough T., Denver
Carmody, Dr T. E., Denver
Central Jewish Aid Society, Denver
Colorado Springs Branch Colorado Tuberculosis Association, Colorado Springs
Colorado Tuberculosis Association, Denver
Compton, Major Arthur G., Denver
Corper, Dr. H. J., Denver
Corwin, Dr. R. W., Pueblo
Craig Colony, Edgewater
Craighead, Dr. Joseph W., Pueblo
Crouch, Dr. J. B., Colorado Springs
Cryer, W. H., Colorado Springs
Denver Tuberculosis Society, Denver
Downing, Dr. Edgar D., Woodmen
Drea, William F., Colorado Springs
Edson, Dr. Carroll E., Denver
Elmslie, Mrs. William G., Colorado Springs
Evangelical Lutheran Sanatorium, Wheatbridge
Flancher, Leon H., Fort Lyon
Forster, Dr. A. M., Colorado Springs
Foster, Alexis C., Englewood
Foster, Mrs. Alexis C., Englewood
Frank, Dr. Robert T., Denver
Gano, George W., Denver
Gardiner, Dr. Charles F., Colorado Springs
Gauss, Dr. Harry, Denver
Gelien, Dr. J., Denver
Gengenbach, Dr. Frank P., Denver
George, Dr. McLeod M., Denver
Giese, Dr. Charles O., Colorado Springs
Gilbert, Dr. G. Burton, Colorado Springs
Gilbert, Dr. O. M., Boulder
Goodson, Dr. H. C., Colorado Springs
Hall, Dr. J. N., Denver
Harris, Dr. Clinton E., Woodmen
Hart, Dr. James A., Colorado Springs
Hays, Dr. Benjamin, Fort Lyon
Heller, Dr. Frederica M., Pueblo
Hoagland, Dr. Henry W., Colorado Springs
Holden, Dr. G. W., Denver
Hull, Dr. Howard L., Las Animas
Innes, F. N., Denver
Jewish Consumptives Relief Society, Denver
Jones, Asa T., Colorado Springs
Jones, Mrs. Guilford, Denver
Jones, Dr. S. Fosdick, Denver
Kramer, Dr. C. S., Woodmen
Lennox, Paul M., Colorado Springs
Levy, Dr. Robert, Denver
Little, Dr. W. T., Canon City
Loomis, Dr. P. A., Colorado Springs
McConnell, Dr. John F., Colorado Springs
McDurmitt, Mrs. R. O., Colorado Springs
McMenamin, Rev. Hugh L., Denver
McPhee, William P., Denver
Madsen, Rev. J., Brush
Mahoney, Dr. Joseph J., Colorado Springs
Markel, Dr. C., Denver
Meader, Dr. Charles N., Denver
Minnig, Dr. Arnold, Denver
Mullin, Dr. W. V., Colorado Springs
Neulinger, Dr. A. J., Colorado Springs
Olcott, Charles T., Boulder
Pace, Dr. J. G., Woodmen
Pershing, James H., Denver
Roberts, Dr. Stanley J., Canon City

Rollins, Miss Flora, Denver
Ryder, Dr. Charles T., Colorado Springs
Sachs, Henry, Colorado Springs
Schaefer, Dr. S. W., Colorado Springs
Schirmer, Godfrey, Denver
Sevier, J. A., Colorado Springs
Sewall, Dr. Henry, Denver
Shardlow, Miss Lois L., Colorado Springs
Shoup, Oliver H., Denver
Simon, Dr. S., Denver
Stearns, Mrs. T. B., Denver
Swan, W. H., Colorado Springs
Strachan, James, Colorado Springs
Swayne, S. E., Colorado Springs
Swezey, Dr. Samuel, Denver
Taussig, Dr. Arnold S., Denver
Thacher, Mrs. M. D., Pueblo
Tygart, Dr. C. A., Denver
Vaile, Miss Gertrude, Denver
Van Kleeck, Henry, Denver
Visiting Nurse Association, Denver
Waring, Dr. James J., Denver
Watt, Dr. Henry C., Colorado Springs
Webb, Dr. G. B., Colorado Springs
Welborn, J. F., Denver
Weld County Public Health Association, Greeley
Winston, A. L., Maniton

CONNECTICUT

Allis, Wallace S., Norwich
Arnold, Dr. E. H., New Haven
Barlow, Major Nathan, New Haven
Bennett, W., New Haven
Blumer, Dr. George, New Haven
Bronson, Miss J. C., New Haven
Bronson, Miss Margaret, New Haven
Brooker, Charles F., Ansonia
Buckland, Edward G., New Haven
Burgess, Mrs. Florence, Wallingford
Campbell, Dr. Hugh B., Norwich
Cheney, Hon. L. R., Hartford
Collier, Dr. M. H., Hartford
Conlan, Miss Mary E., New Haven
Connecticut State Library, Hartford
Connecticut State Tuberculosis Commission,
Dr. Stephen J. Maher, Representative Member, Hartford
Coulton, Mrs. Homer B., Milford
Dana, Miss M. T., New Haven
Department of Health, Bridgeport
Elton, John P., Waterbury
Employees Tuberculosis Relief Association, Bridgeport
Employees Tuberculosis Relief Association, New Haven
English, Henry F., New Haven
English, Joel F., New Haven
Farnam, Prof. Henry W., New Haven
Fenn, Bruce, New Haven
Findley, Mrs. F. C., New Haven
Fisher, Prof. Irving, New Haven
Foltz, Major J. Clinton, New Haven
French, Roy L., Meriden
Gibson, Dr. Cole B., Meriden
Gillis, Miss M., Waterbury
Godfrey, Jonathan, Bridgeport
Goodridge, Dr. Fred K. G., Pomfret Center
Greenway, Dr. James C., New Haven
Greenway, Mrs. James C., Greenwich
Hartford Society for the Prevention of Tuberculosis, Hartford
Honey, Dr. James A., New Haven
Hooker, Dr. Edward B., Hartford
Ingersol, Mrs. Colin, Salisbury
Jacobs, Louis L., New Haven
Keiffer, Jean, Norwich
Kimball, A. R., Waterbury
Kingsbury, Dr. Isaac W., Hartford
Knies, Fred, New Haven
Law, Miss Evelyn R., Madison
Leeds, Mrs. Norman, Bridgeport
Low, Mrs. F. E. C., Watertown
Lyman, Dr. David R., Wallingford
Lynch, Dr. Edward J., Shelton
Maher, Dr. Stephen J., New Haven
Milligan, Edward, Hartford
Moran, James T., New Haven
Morey, Dwight J., Bristol
Morris, C. D., Wallingford
Morriss, Dr. W. H., Wallingford
Murphy, Dr. James E., Hartford
New Haven County Anti-Tuberculosis Association, Wallingford
New London Anti-Tuberculosis Society, New London
O'Brien, Dr. John F., Niantic
Palmer, Mrs. I. E., Middletown
Pitman, Miss Elizabeth S., Wallingford
Pitman, Miss Helen C., Wallingford
Platt, F. G., New Britain
Porter, Dr. William, Jr., Hartford
Prudden, Miss Lillian, New Haven
Riggs, T. Lawrason, New London
Sheehan, Miss Anna M., New Haven
Skiff, Dr. Walter C., New Haven
Smith, Ernest W., Hartford
Smith, Mrs. Edmund, Stamford
Southington Public Health Association, Southington
Stack, Miss Margaret K., Hartford
State Board of Charities, Hartford
State Department of Health, Hartford
Steiner, Dr. Walter R., Hartford
Stockwell, Dr. William, Hartford
Stoll, Dr. Henry Farnum, Hartford
Swain, Dr. Henry L., New Haven
Talcott, John G., Talcottville

Tod, Mrs. J. Kennedy, South Beach
Trumbull, Henry, Plainville
Tuttle, Mrs. H. B., Naugatuck
Ullman, Isaac, New Haven
Visiting Nurse Association, Milford
Visiting Nurse Association, New Haven
Visiting Nurse Association, Stamford
Wales Lines Company, Meriden
Warner, William A., New Haven
Watson, Mrs. L. E., West Haven
Weber, Mrs. E. Y., Stamford
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Hemenway, Augustus
Hemenway, Mrs. Augustus
Hill, George S.
Honeij, Dr. James A.
Houghton, Clement S.
Houghton, Miss Elizabeth G.
*Hunnewell, Walter
Hyams, G. M.
Jackson, Miss Marian C.
Johnson, Arthur S.
Johnson, Dr. F. W.
Joslin, Dr. Elliott P.
Kelley, Dr. Eugene R.
Kirstein, Louis E.
Lee, Joseph
Locke, Dr. Edwin A.
Lord, Dr. F. T.
Loring, Mrs. William Caleb
Loring, Judge William Caleb
Lowell, Miss Lucy
McCarthy, Dr. Francis
MacAdam, Miss Ellen C.
Mason, Miss E. F.
Mason, Miss Ida
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Minot, Dr. George R.
Minot, Dr. James J.
Mintz. Dr. Samuel C.
Morrison, Dr. Hyman
Munro, Josiah G.
Murphy, Dr. Timothy
O'Brien, Dr. John F.
Otis, Dr. Edward O.
Page, Dr. Calvin Gates
Park, Dr. William E.
Parks, F. R.
Peabody, Harold
Pratt, Dr. Joseph H.
Putnam, Mrs. W. Lowell
Robeson, Miss H. A.
Saltonstall, Mrs. R. M.
Sears, Miss A. L.
Sears, Dr. George G.
Shattuck, Dr. F. C.
Shattuck, Dr. George C.
Simes, Mrs. William
Slocum, Miss Laura
Smith, Jeremiah, Jr.
Stevens, Edward F.
Stone, Nathaniel H.
Sturgis, Francis S.
Thorndike, Dr. Augustus
Van De Linda, Frank
Waite, Mrs. Elizabeth W.
White, Dr. Benjamin
Williams, Dr. Francis H.
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Woodward, Dr. William C.

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Adams, Miss Lillian, Pittsfield
Adriance, Dr. Vanderpoel, Williamstown
Adriance, Mrs. Vanderpoel, Williamstown
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Alley, Dr. Leon A., Rutland
Ames, Mrs. James B., Cambridge
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Bill, Nathan D., Springfield
Borden, R. P., Fall River
Bowditch, Edward, West Roxbury
Bradley, Rosamond, Prides Crossing
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Burgess, Miss Katharine Brookfield, Great Barrington
Bushnell, Col. George E., Bedford
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Clark, Dr. Leonard B., Waverley
Clark, Dr. Thomas F., Taunton
Clarke, Dr. Israel J., Haverhill
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Colt, Dr. Henry, Pittsfield
Coolidge, Dr. Sumner, Middleboro
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Darling, Dr. Eugene A., Cambridge
Davidson, Dr. William B., Rutland
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Gay, Mrs. Josephine, Brookline
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Gray, Edward, Milton
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Hampshire County Public Health Association, Northampton
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Hunt, Dr. F. H., Mattapan
Hyams, Miss Isabel F., Dorchester
Jamieson, Mrs. J. B., Jr., Newton Center
Jaques, Dr. Henry P., Lenox
Jones, Miss Amelia H., New Bedford
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Lathrop, William H., Newtonville
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Lawrence, Mrs. W. A., Lynn
Lee, Dr. Roger I., Cambridge
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Losell, Mrs. Joseph N., Whitinsville
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Public Health Dispensary, Beverly
Quincy Anti-Tuberculosis Association, Quincy
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Saltonstall, Mrs. Robert, Readville
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Sheldon, C. L., Watertown
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Smith, Mrs. Mabel Greeley, Cambridge
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Stone, Dr. Ralph E., Beverly
Swan, Dr. William D., Cambridge
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Thayer, John E., Lancaster
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Farr, Merton E., Detroit
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Garvin, Dr. A. H., Northville
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Gratiot County Good Health Society, Alma
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Michigan Tuberculosis Association, Lansing
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Schlotman, Mrs. J. B., Detroit
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* Deceased

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WILSON, DR. CHARLES A., Detroit
ZIWET, PROF. ALEXANDER, Ann Arbor

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CALLAHAN, DR. F. F., Pokegama
CARPENTER, E. L., Minneapolis
CARPENTER, MRS. E. L., Minneapolis
CHESLEY, DR. A. J., St. Paul
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DAUGHERTY, DR. EDWIN B., St. Paul
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FARRINGTON, R. I., St. Paul
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GALE, E. C., Minneapolis
GREENE, DR. CHARLES LYMAN, St. Paul
GRIGGS, T. W., St. Paul
HACKING, FRANK H., Minneapolis
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HEGARDT, W. G., Duluth
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LONG, DR. WILLIAM H., Rochester
LYMANHURST SCHOOL FOR TUBERCULOUS CHILDREN, Minneapolis
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MILAN, DR. M. GEORGE, Thief River Falls
MINNESOTA PUBLIC HEALTH ASSOCIATION, St. Paul
MINNESOTA STATE ADVISORY COMMISSION, St. Paul
MINNESOTA STATE BOARD OF HEALTH, St. Paul
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PRATT, F. J. AND T. J., Minneapolis
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ROTHENBURG, DR. J. C., Springfield
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SCOFIELD, DR. C. L., Benson
SEITER, H. F., Tracy
SHERMAN, DR. CHARLES L., Luverne
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SOUTHWESTERN MINNESOTA SANATORIUM, Worthington
SPICER, DR. FRANK W., Duluth
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STRADER, DR. ERNEST L., Cannon Falls
SUND AND DUNHAM, Minneapolis
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SWEDISH HOSPITAL, Minneapolis
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WADE, MISS E. M., Minneapolis
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WITTICH, DR. F. W., Minneapolis
WOOLWAY, DR. C. J., Deerwood
ZONNE, A. E., Minneapolis

* Deceased

MISSISSIPPI

Boswell, Dr. Henry, Sanatorium
Denman, Dr. W. E., Philipp
Jones, Dr. May F., Sanatorium
Mississippi Tuberculosis Association, Dr. Henry Boswell, Representative Member, Jackson
Shands, Dr. H. R., Jackson
Truelore, Miss Fay, Brandon

MISSOURI

Adams, Fred B., St. Louis
American Nurses Association, St. Louis
Bixby, W. K., St. Louis
Bedal, Dr. Adelheid C., St. Louis
Benjamin, Alfred, Kansas City
Bernard, Dr. B. C., Koch
Bixby, W. K., St. Louis
Bogard, Dr. Edward, St. Louis
Boisliniere, Dr. Louis C., St. Louis
Boyd, Ingram F., St. Louis
Bredeck, Dr. Joseph F., St. Louis
Buddy, Dr. E. P., St. Louis
Burnap, F. P., Kansas City
Butler Manufacturing Company, Kansas City
Carpenter, Mrs. G. O., St. Louis
Day, Dr. Anthony B., St. Louis
Dock, Dr. George, St. Louis
Emery, Bird, Thayer Dry Goods Company, Kansas City
Fischel, Dr. Walter, St. Louis
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Gradwohl, Dr. R. B. H., St. Louis
Grimmer, Miss Margaret, St. Louis
Hall, F. L., Kansas City
Hall, Homer, St. Louis
Hall, J. C., Kansas City
Health Service Bureau, St. Louis
Hoxie, Dr. George H., Kansas City
Huffman, Dr. J. W., Koch
Jasper County Tuberculosis Hospital, Webb City
Jewish Home for Chronic Invalids, Anglum
Jonas, Mrs. Ernest, St. Louis
Jones, A. W., Jr., St. Louis
Jones, H. McK., St. Louis
Kansas City Star, Kansas City
Kansas City Tuberculosis Society, Kansas City
Keith, Robert, Furniture Company, Kansas City
Kemper, W. T., Kansas City
Kirkwood, Irwin R., Kansas City
Lamb, Dr. D. R., St. Louis
Library of Jackson County Medical Society, Kansas City
Lipsitz, Mrs. Babette Kahn, St. Louis
Long, R. A., Kansas City
Mallinckrodt, Edward, St. Louis
Mardorf, Dr. William C., St. Louis
Missouri State Sanatorium, Mt. Vernon
Missouri Tuberculosis Association, St. Louis
Mudd, Dr. Harvey G., St. Louis
Opie, Dr. Eugene L., St. Louis
Orr, Isaac H., St. Louis
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Ridenour-Baker Grocery Company, Kansas City
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Saunders, Dr. E. W., St. Louis
Schlenker, Dr. Lawrence, St. Louis
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Smith, Lansing F., St. Louis
St. Louis Children's Hospital, St. Louis
St. Louis Tuberculosis Society, St. Louis
Tuholske, Dr. Hermann, St. Louis
Veeder, Dr. Borden S., St. Louis
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Woolf, H. M., Kansas City
Zozaya, Jose, St. Louis

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Campbell, Dr. Donald, Butte
Montana Tuberculosis Association, H. R. Cunningham, Representative Member, Helena
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Gifford, Dr. Harold, Omaha
Heagey, Dr. F. W., Omaha

Jonas, Dr. A. F., Omaha
McCabe, Miss Florence, Omaha
Marshell, Miss Alice, Omaha
Moyer, Dr. Torrence C., Lincoln
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Snell, N. Z., Lincoln
Standard Oil Company, Omaha
Trimble Brothers, Omaha
Underburg, Mrs. Edith M., Stanton
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Ziegler, Dr. Charles H., Vesta

NEVADA

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Gile, Dr. John M., Hanover
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Kerr, Dr. Robert B., Manchester
Kimball, Miss Martha S., Portsmouth
McDerby, Miss Anna F., Concord
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Perry, Dr. C. E., Glencliff
Smith, J. Brodie, Manchester
Upham, Dr. Samuel R., Claremont
Woods, E. B., Hanover

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Adriance, Rev. Harris Ely, Englewood
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Bergen County Tuberculosis Hospital, Oradell
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Bruce, Miss Margaret, Belleville
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Cadbury, Joel, Moorestown
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Cochran, Mrs. James Blair, Plainfield
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Gantt, Miss Laura, Belleville
Goodnow, Mrs. Belle Thompson, Glen Gardner
Griesemer, Dr. Z. L., Roselle
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Hance, Dr. Irwin H., Lakewood
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Lee, Charles T., Montclair
Lewis, Col. I. N., Montclair
Mabie, Mrs. Hamilton W., Summit
Mabie, Miss Helen R., Summit
Mackenzie, K. G., Nutley
Marshak, Dr. M. I., Bayonne
Marvel, Dr. Philip, Atlantic City

Mellon, Mrs. Charles H., Morristown
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Meyer, Dr. William, West Hoboken
Mills, David B., Montclair
Montclair Tuberculosis Association, Upper Montclair
Moore, Dr. George R., Trenton
Moore, Mrs. Paul, Convent
Morris County Tuberculosis Association, Morristown
Nevin, Dr. John, Jersey City
Newcomb, Dr. Marcus W., Brown's Mills-in-the-Pines
New Jersey Tuberculosis League, Newark
Nielsen, Miss Marie, Perth Amboy
Paterson Anti-Tuberculosis League, Paterson
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Rogers, Dr. Lawrence H., Trenton
Runnells, Dr. John E., Scotch Plains
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Sexsmith, Dr. G. H., Bayonne
Shalet, Dr. Louis, West New York
Shreve, Mrs. E. G., Pleasantville
Silk, Dr. Charles I., Perth Amboy
Sinclair, Mrs. D. B., Princeton
Smith, Hazlitt, Camden
Smith, Prof. Theobald, Princeton
Stillman, Dr. Ralph G., Rahway
Stromberg, Mrs. Gustaf, New Brunswick
Stults, F. E., Morristown
Thompson, Mrs. L. S., Red Bank
Titsworth, Charles Grant, Newark
Tomlinson, Mrs. R. E., Montclair
Tyler, William S., Plainfield
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Unity Church, Montclair
Van Raalte, Morton E., Paterson
Vinciguerra, Dr. Michael, Elizabeth
Visiting Nurse Association, Atlantic City
Visiting Nurse Association, Woodbury
Worth, Dr. Collen M., Trenton

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Anderson, Dr. H. M., Valmora
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Beatty, P. A., Fort Bayard
Brown, Dr. R. O., Sante Fe
Brown, Dr. William T., Valmora
Bullock, Dr. E. S., Silver City
Butzke, Ernest J., Fort Bayard
Chevaillier, Dr. A. M., Gallup
Fahlen, Dr. Frederick T., Silver City
Fine, Henry Masten, Fort Bayard
Harris, Dr. J. E. J., Albuquerque
Leverton, Surgeon W. R., Fort Bayard
Loving, Dr. R. S., Fort Bayard
McFaul, Dr. William D., Fort Bayard
McLellon, G. E., Albuquerque
McNall, Major James N., Fort Bayard
Mann, S. J., Fort Stanton
Mauger, W. E., Albuquerque
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Mulky, Dr. Carl, Albuquerque
Mumey, Dr. Nolie, Greenville
Peters, Dr. Leroy S., Albuquerque
Reid, Dr. H. P., Fort Stanton
Reidy, Dr. J. A., Albuquerque
Shamaskin, Dr. Arnold, Fort Bayard
*Shortle, Dr. A. G., Albuquerque
Valmora Institute, Valmora
Warner, Dr. H. J., Fort Stanton
Whitcomb, Dr. O. J., Raton

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American Public Health Association
American Red Cross, Health Service Department
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Anderton, Dr. Walter P.
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Arnstein, Leo
Arnstein, Mrs. Leo
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Aspinwall, J. Lawrence
Asserson, Dr. M. Alice
Auchincloss, Mrs. C. C.
Babbott, Frank L.
Bannard, Otto T.
Beer, Dr. Edwin
Beer, Mrs. Julius
Behr, Herman
Bertholf, Mrs. Mary T.
Bier, Mrs. Sylvan
Biggs, Dr. Hermann M.
Blum, Dr. Charlotte
Blumenthal, Hugo

* Deceased

*Bogue, Dr. E. A.
Bond, Miss Kate
Brandt, Harry J.
Brannan, Dr. John W.
Brecher, E. A.
Brewster, George S.
Bridge, Dr. Norman
Brill, Dr. N. E.
Bristol, John I. D.
Bronson, Dr. E. B.
Brown, Alfred L.
Budington, Dr. Walter I.
Bulkley, Jonathan
Bullen, Dr. Bernard C.
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Caeser, Henry A.
Caldwell, Otis W.
Campbell, James F.
Canfield, George F.
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Carleback, Dr. Walter M.
Carman, Dr. A. R.
Carter, Mrs. Ernest T.
Carter, Ernest T.
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Cauldwell, Dr. Charles M.
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Coleman, Dr. Warren
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Franklin, Lewis B., Flushing
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SINGER, DR. EMANUEL, Liberty

* Deceased

Smith, Mrs. Helen, Yonkers
Smith, Dr. Herbert L., Watertown
Smith, Dr. John A., Saranac Lake
Smith, Miss Margaret S., Spring Valley
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Trudeau, Dr. F. B., Saranac Lake
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North Dakota State Tuberculosis Sanatorium, Dunseith
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Wick, Mrs. Elizabeth G., Youngstown
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Mackay, Miss Rosalind, Okalhoma City
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Visiting Nurse Association, Portland

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de Roux, Dr. Luis, City of Panama

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McCague, Dr. Edward J., Pittsburgh
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Macfarland, Judge James R., Pittsburgh

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Reading Sanatorium for Treatment of Tuberculosis, Reading
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Woman's Anti-Tuberculosis League of Peru, Lima

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KNEECE, DR. B. E., Batesburg
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Hendricks, Dr. C. M., El Paso
Hill Crest Sanatorium, Boerne
Hill, Hon. Hood, Pharr
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